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A MANUAL FOR STUDENTS AND PRACTITIONERS.

BY

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and Surgeons, New York; Visiting Surgeon Bellevue Hospital, New York,*

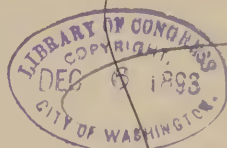
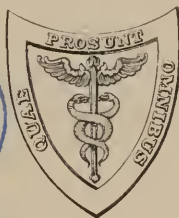
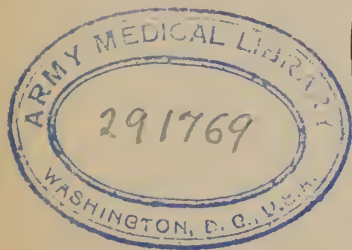
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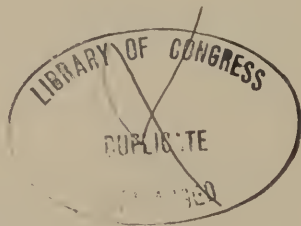


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P R E F A C E.

I HAVE been engaged for a number of years in teaching Surgery both theoretically to students and in its practical aspects to graduates of medicine in hospitals and dispensaries. From this experience I became convinced that a book written not as a compend or digest of Surgery, but rather as one which would *explain*, would prove of advantage. Among the principles of Surgery, Inflammation is one the clear comprehension of which seems attended with peculiar difficulties. Therefore in writing this book one of the main purposes has been to elucidate this subject fully, and in doing so a method differing somewhat from that found in the regular text-books has been pursued. In connection with this it will be observed that under Bacteriology neither the "specific" pathogenic bacteria nor the saprophytes are credited with any pyogenic functions. This course has been followed simply for the sake of making clearer the *theory* of the bacterial origin of inflammation, and with no intention whatever of controverting the latest discoveries, which seem to show that all bacteria, whether pathogenic or saprogenic, are more or less capable of producing pus. Strictly speaking, therefore, the use of the terms "specific" and "non-specific" would be incorrect as applied to bacteria. But as it is a fact that the *varieties* of inflammation *themselves* are recognized as being either "specific" or "non-specific," and that putrefaction is a process distinct from inflammation, it was deemed best to avoid all discussion, and to classify the bacteria as *causes* in the same way in which their *effects*—*i. e.* inflammation and putrefaction—are classified.

In addition to inflammation, three other subjects have received especial attention, and for similar reasons. These subjects are Tumors and Cysts, Brain Surgery, and Abdominal Surgery. In dealing with them only fundamental principles have been discussed,

all *operative technique* having been omitted, except in the case of Abdominal Surgery, in which most of the intra-abdominal operations have been described.

I am greatly indebted to Dr. Chas. N. Dixon-Jones of this city for the entirely independent authorship of the following portions of the book :

Sections : Injuries and Diseases of Muscles, Tendons, and Bursæ ; of the Circulatory System ; Amputations ; Anaesthesia ; Plastic Surgery ; Injuries of the Larynx. *Subsections* : Injuries and Diseases of the Nerves ; of the Chest-wall, Lungs, and Pleuræ ; Abdominal Section ; Operations on the Stomach ; Operations on the Intestines ; Operations on the Liver and Gall-bladder ; Operations on the Spleen and Pancreas ; Hernia, except the paragraphs relating to anatomical varieties of inguinal hernia, and symptoms and treatment of strangulated hernia. *Paragraphs* : Ligatures ; Drainage ; Sutures ; Arrest of Hemorrhage ; Surgical Dressings ; Symptoms and Treatment of Spinal Inflammation ; Description of Operation for Appendicitis ; Traumatic Delirium Tremens ; Treatment, Operative and Conservative, of the Varieties of Intestinal Obstruction ; Diseases of the Omentum.

The text-books consulted in the preparation of this book are as follows :

The American Text-Book of Surgery ; Senn's *Principles of Surgery* ; Treves' *Operative Surgery* ; Greig Smith's *Abdominal Surgery* ; Moullin's *Surgery* ; the *Surgeries* of Koenig, Tillmann, Albert, Roberts and Druitt ; Billroth's *Surgical Pathology* ; and Delafield's *Lectures on Pathology*. The writings in current literature of the following authors have also been drawn upon : W. T. Bull, R. F. Weir, Charles McBurney, L. A. Stimson, R. Abbe, Halstead, Keen, J. D. Bryant, Roswell Park, F. Hartley, F. H. Markoe, and various German surgeons whose contributions are found in the *Centralblatt für Chirurgie*.

BERN B. GALLAUDET.

NEW YORK CITY, November, 1893.

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SURGERY.

CONTUSIONS AND WOUNDS.—THE PROCESS OF REPAIR.

What are the varieties of traumatism or injury ?

Injuries are divided into *contusions* and *wounds*. As applied to the muscles and connective-tissue planes a *contusion* is an injury over which the *skin remains intact*; a *wound* is an injury over which the *skin is not intact*—i. e. it has been torn or cut by the same violence that produced the injury. As applied to the viscera, the same idea prevails, except that the condition of the *surface* of the organ, instead of that of the skin, is taken as the criterion; e. g. a contusion of the liver or spleen is an injury in which the *surface* of the organ is intact, whereas a *wound* of the same means an injury involving the surface as well.

A wound may be produced by a force which presses the soft parts against a sharp edge or ridge of bones.

What is the pathology of an "injury"?

The area of tissue involved of course varies. The actual condition of this area is as follows: The tissue-structure is torn and lacerated or severed; there is a similar condition of the blood-vessels and lymphatics, together with an effusion of blood and lymph. Contusions vary simply in extent and severity. A bruise is a small contusion. Wounds, on the contrary, present varieties which are dependent on the cause (by some authorities "injuries" are spoken of as "wounds," and these "wounds" are divided into "closed" wounds and "open" wounds, the former corresponding to *contusions* and the latter to *wounds*).

What are the varieties of wounds ?

Incised, lacerated, and punctured.

Incised Wounds: These are *clean cut*, made by a sharp-edged instrument, have a definite length and a gaping of their edges.

Lacerated Wounds: These are wounds in which the tissues are torn or crushed; the instrument is dull or blunt, teeth of animals, end of a club, etc.; and there may be considerable undermining of the skin, which, of course, is also torn. If the skin-edges of such a wound happen to be bruised, then the term "contused wound" may be employed, not to be confounded, however, with contusion.

Punctured Wounds: These are made by pointed instruments or by bites and stings of insects, and are of varying depths. When the wound communicates with a cavity, as of the abdomen, it is called a penetrating wound. Wounds produced by missiles thrown by the *explosion of gunpowder* are punctured or lacerated, and are simply called *gunshot wounds*. *Hemorrhage* is always a symptom of all these varieties of wounds.

What is the treatment in general of wounds and contusions?

Of Contusions: Rest, moderate warmth, and pressure. These ends are best obtained by wrapping the part in ordinary cotton and applying a snug bandage.

Of Wounds: This depends on the kind of wound involved. All wounds should be cleansed and the hemorrhage stopped. The after-treatment varies:—

Lacerated wounds should be packed with iodoform gauze, rather than sutured, for the reason that they cannot be rendered, as a rule, even by the most careful cleansing, sufficiently aseptic to admit of suture and primary union. They heal by granulation. This is the *open* method of wound-treatment.

Punctured wounds are similarly treated, preliminary enlargement being made when necessary, indicated by retained blood, presence of dirt, etc. If they are small or exceedingly narrow, cleansing of the skin and the application of a dressing without drainage will be all that is necessary. The gauze packing is for drainage.

Incised wounds should be sutured—i. e. their edges brought together and held in place by *sutures*. Drainage is rarely indicated for these wounds, unless their cavities cannot be obliterated by the sutures and the pressure of the subsequent dressing. Strands of catgut and horse-hair, rubber and glass tubes, are the means commonly used for this purpose. They of course occupy the deep part of the wound, and over them the edges are brought together

by the sutures. Tubes are sometimes used to drain lacerated and punctured wounds.

The method of "*cleansing*" a wound or rendering it aseptic is the same for all wounds, and is identical with that given for compound fractures, abdominal operations, etc. (which see).

The *after-dressing* is also the same for all wounds, and is that given below. In incised wounds a strip of iodoform gauze may be laid over the line of sutures before the absorbent gauze and cotton are applied. Some surgeons recommend a strip of rubber tissue in place of the iodoform gauze. An incised wound made for operation purposes differs in no respect from a similar wound made by accident, except that it requires no "*cleansing*," because the skin has already been made clean by the method referred to above for wounds.

Describe the treatment for "poisoned" punctured wounds.

Punctured wounds inflicted by the stings of insects or the fangs of reptiles should be treated by thorough disinfection. Venomous snake-bites are usually accompanied by rapid and multiple hemorrhagic cellulitis. There may be paralysis of the respiratory and spinal centres. Locally, there is marked swelling of the integument and cellular tissues. Profound prostration or collapse may ensue. The constitutional remedy is alcohol freely administered.

The local treatment should be a ligature above the seat of the wound, free excision of the wound, and extraction of the poison by sucking, cupping, or cauterization, followed by subsequent antiseptic treatment. Hypodermic injections of permanganate of potash in solution into the surrounding tissues are of value.

How are gunshot wounds produced?

By projectiles thrown by the explosive force of gunpowder. These wounds partake of the character of a contused and lacerated wound. Where there is extensive crushing of a part, as by a cannon-ball, the accompanying shock is profound. The wound made where the missile *enters* is called the *wound of entrance*; where it leaves the body it is called the *wound of exit*. These wounds are usually aseptic, and precautions taken to prevent subsequent infection will usually be followed by excellent results. It is not always necessary to remove the projectile. In case of injury involving large blood-vessels or the abdominal viscera immediate interference is necessary. Such operations should be performed

under the most rigid antiseptic precautions. The wound should be temporarily dressed with moist antiseptic gauze until proper examination and dressing can be made. Amputation will be necessary when the parts are greatly shattered or large blood-vessels injured, or, if spreading, gangrene results.

What are the indications for removing a dressing from a wound ?

Incised wounds without drainage or with catgut drainage, and without symptoms of sepsis, require no change for a period, varying with the size of the wound, from ten days to two weeks. At the end of this time union is usually complete. With other drainage the dressing should be changed on the third day and the tubes shortened or removed. Excessive discharge through the dressing always indicates renewal, as do also the symptoms of sepsis. *Lacerated wounds* should be dressed every other day, or every day if suppuration is present. If healing normally, at the second or third dressing, gauze soaked in balsam of Peru or other "stimulant" should be substituted for the iodoform.

The dressings of *punctured wounds* are changed according as their treatment has been that of incised or of lacerated wounds.

Arrest of hemorrhage, sutures, and drainage will now be considered in detail, together with some additional points in dressing.

How is hemorrhage arrested ?

Bleeding points are well exposed, and immediately seized with pressure forceps, which should grasp the points completely, and include no more of the surrounding tissue than is absolutely necessary. Simple oozing is stopped by *pressure* or the *use of hot water*. Hemorrhage from vessels of a small size usually ceases by the time it becomes necessary to remove the artery forceps (*foreipressure*), but if not, such vessels may be twisted (*torsion*). The larger arteries and main vessels require the application of a *catgut ligature*. The bleeding from vessels in inflamed tissues is controlled with more difficulty. Frequently it will be necessary to encircle bleeding points with a curved needle and catgut, which on being tied closes the bleeding orifice. In the case of a torn or retracted vein which cannot be grasped with a ligature, the area of bleeding may be plugged up with iodoform gauze, which is held in place until coagulation occurs.

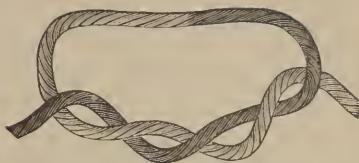
The *ligature* is the best and safest method of controlling hemorrhage, and either the flat or reef (Fig. 1), or surgeon's knot (Fig. 2),

FIG. 1.



Flat or Reef Knot (J. D. Bryant).

FIG. 2.



First Tie of Surgeon's or Friction Knot. The second tie is like that of the flat knot (J. D. Bryant).

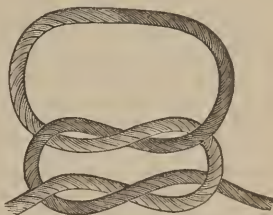
should be used. These should not be confounded with the "granny knot" (Fig. 3), which is insecure.

Acupressure is the insertion of a needle through the tissues on each side of a bleeding point in such a way as to cause compression of the vessel. (Further details of arresting hemorrhage are given under Treatment of Wounds of Arteries.)

What materials are used for ligatures and sutures?

Catgut, silk, and silkworm gut. Silver wire is also useful, especially in wiring fractures. Catgut is the best material for tying vessels and for many forms of sutures. Well-prepared catgut can be purchased from the instrument-makers or may be prepared by the surgeon himself. The simplest way is to boil the catgut for an hour or so in alcohol 95 per cent. A more elaborate way is as follows: It is bought in raw hanks, and soaked for two weeks in sulphuric ether, in order to dissolve out the fat. After drying in a sterilized towel, it is immersed in a watery solution of corrosive sublimate, of a strength of 1:1000, for twenty-four hours. From this it is transferred to a jar of absolute alcohol, in which it is boiled for several hours in a water-bath, or an Arnold's sterilizer, the lid of which is left open. The paper tied over the jar should be pierced with several pin-holes to prevent an explosion. Finally, it is placed in another jar of alcohol and preserved for future use.

FIG. 3.



Granny Knot, which is never used in surgery (J. D. Bryant.)

What are the uses of silk ?

Silk is used for sutures and for ligatures in certain intra-abdominal operations and for suture of the intestines. When used for suture it must be removed from the wound on about the eighth day. Fine black silk is used in plastic surgery of the neck and face. Silk is sterilized by boiling, or steaming for a half hour in a sterilizer.

When is silkworm gut used ?

Silkworm gut is a very good material for almost all wounds. It is strong, smooth, and pliable. It may remain buried almost indefinitely in the tissue, without irritation. It is prepared for use by simple boiling or steaming.

All sutures should be tied or fastened at *one side of*, and not over, the wound itself.

Describe the different forms of suture.

The main forms of sutures usually employed are the interrupted, the continuous, and the twisted or pin suture.

The *interrupted suture* (Fig. 4) is made by carrying the thread across the wound, cutting it off, and fastening the ends by tying, twisting, or clamping with perforated shot. This is repeated at intervals along the wound. The *pin suture* is made by passing a pin through the lips of the wound and holding it there by a thread wrapped around it, forming a figure of 8.

FIG. 4.



Interrupted Suture of Silk, showing the lower stitch too tightly tied.

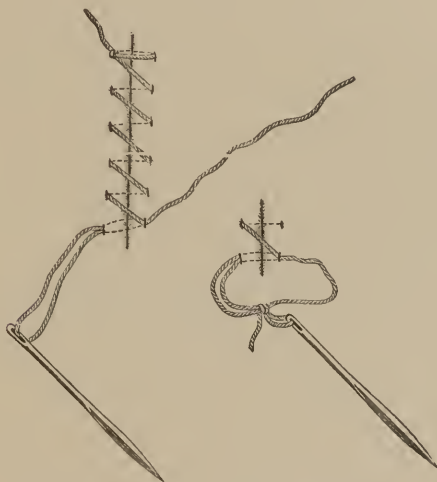
Continuous or *continued sutures* (Fig. 5) differ from interrupted sutures in that the first stitch is taken near the end of the wound, and the thread is passed through the tissues from one side to the other, without being cut off and tied each time the edges of the wound are crossed. The continuous suture can be inserted more rapidly than the interrupted.

The *quilted suture* is a form of interrupted suture. The suture is passed through the edges of the wound, and then brought back again and tied. The *loop* is on the side opposite to the *knot*, and the thread does not pass *over* the line of the conjoined edges of the wound, as in the regular form.

What are buried sutures?

They are used for the obliteration of the wound-cavity. In deep wounds an initial row of buried catgut sutures may be used by passing with a curved needle stitches through the tissues of the

FIG. 5.



Showing Beginning and Final Knot of Continued Suture.

two sides of the wound, well below the integument, and tying them before the skin sutures are inserted. These are also employed in adjusting the surfaces of amputation-flaps. Deep sutures should be used as sparingly as possible, as they may interfere with the circulation.

In tying any form of suture the *friction knot* should be used to prevent slipping. In closing wounds where the flaps are tense and the sutures will be exposed to severe strain, *supporting* or *retentive sutures*, including much more of the wound-margins and taking a good hold on the tissues, have to be inserted. These are placed two inches from the wound-edges and at intervals of three-fourths of an inch; between these *retentive sutures* the *smaller* or *approximating* sutures are inserted.

Sutures should not produce tension or include large masses of

bruised or damaged tissue. *Buried skin sutures* taken from the *under surface* of the skin, so as not to penetrate the *infected sebaceous glands*, have been highly recommended by some surgeons.

What are the principles of wound-drainage?

Ineised aseptic wounds of ordinary size do not require drainage, or at least nothing more than capillary drainage with a few strands of silkworm or catgut. With an aseptic operation and obliteration of dead spaces by graduated pressure and properly adjusted sutures drainage is really unnecessary, and tends to delay the healing of the wound-surfaces.

Drainage by means of rubber tubes or iodoform gauze packing is indicated in the following conditions:

1. In infected wounds, especially in operations where old sinuses exist or where a persistent fistula is inevitable.
2. In large wounds with sinuous or unobliterated cavities and where much oozing is expected.
3. When inflamed or much-damaged tissue remains in the depths of the wound, or injury and irritation of the tissues have resulted from the manipulations of the surgeon.

What are the different types of dressings used in the antiseptic treatment of wounds?

1. Simple excision;
2. Dry dressings;
3. Moist dressing.

1. In small wounds with *exact coaptation* of the edges the application of certain finely powdered substances ensures the drying up of the serum and blood, with the formation of a firm and unirritating scab. This method is especially indicated after plastic operations about the face. Numerous substances have been recommended for this purpose: iodoform; eucrophin; iodol; aristol; lysol; allumol; iodoform collodion.

2. In large wounds and extensive injuries the oozing is so great that some form of absorbent dressing must be applied. Gauze or cheesecloth is the material almost universally used for operative or accidental wounds. Gauze is rendered aseptic by sterilization or by saturation with some chemical germicide—*i. e.* iodoform, corrosive sublimate, or carbolic acid. Between the wound and the dressing a strip of gutta-serena tissue may be interposed, which, however, is not at all necessary, and may cause ulceration of the edges by preventing the absorption of the exudate.

Various forms of sterilizers are so cheap that in hospital practice a separate sterilizer may be used for each set of dressings. From eight to twenty layers of gauze should cover the wound and the surface for some considerable distance beyond the limits of the wound. A layer of moist iodoform gauze or sterilized gauze dipped in sublimate solution should be placed immediately over the line of union, as slight moisture increases the capillary absorbing power of the dressing. The gauze is covered over with several layers of absorbent cotton, and all are securely held in place by a roller bandage, preferably of gauze also. It is sometimes wise to change the dressing of a large wound attended with much oozing at the end of twenty-four hours, when the drainage-tubes, if used, may be removed. The change of dressing should be done with all the antiseptic precautions employed at an operation. If the fluids do not soak through the dressing, no change should be required for several days. It is well to keep a dressed wounded part exposed to a free circulation of air. In the case of a wound about the pelvis this may be accomplished by the use of a cradle. The air beneath the bed-clothes is apt to become foul.

3. *Moist Dressing.*—In the case of septic wounds, where rapid absorption of the discharges and disinfection of the wound-surfaces are desirable, healing may be promoted by substituting a *wet* antiseptic dressing for the usual dry one. This form of dressing may also be advantageously employed in the treatment of contused and lacerated wounds where the facilities may not be at hand for an antiseptic operation and dry dressing. The wound is dusted over with *iodoform* or *aristol*, and then covered with a large compress of sterilized gauze moistened in a 1 : 1000 corrosive-sublimate or 1 : 60 carbolic solution ; creolin, 1 per cent. ; or aluminum acetate, saturated solution, may also be used. A piece of impermeable material, such as “gutta-percha tissue,” should widely cover the whole dressing, and all is held in place by a loosely-applied roller bandage. It may be desirable to remoisten the dressing every hour or so with a few drachms of the same solution as used.

What is the roller bandage?

Roller bandages are made from plain, sterilized or corrosive-sublimate gauze, and are used for retaining dressings in position, making equable pressure, and restraining motion. The material from which the bandage is made is cut in strips three to ten yards in length and from one-half to four inches in width. It should be applied

evenly and smoothly to the surface by circular and spiral turns, so as to retain its place during the ordinary movements of the patient. Where a firm support is required *muslin*, *canton flannel*, or *flannel* should be the material selected. For producing absorption in the treatment of certain joint diseases by elastic pressure, a roller of pure rubber is used.

Define the process of repair.

This is the process by which tissues which are the seats of wounds or contusions are restored approximately to their former condition. The term "approximately" is used for the reason that the process of repair always results in the formation of an amount of connective tissue *in excess* of that which was originally in the wounded or contused parts. This excessive connective tissue, when the process is complete, is the *cicatrix* or *scar*.

Describe the process of repair.

Absorption of the effused blood and of the destroyed tissue-elements; exudation of lymph, serum, and fibrin: this last forms a sort of framework, so to speak, into which pass white blood-corpuscles, which soon become changed into regular connective-tissue cells. Other new connective-tissue cells are also formed in this "framework" by proliferation from the cells in the surrounding tissues. At the same time new blood-vessels are formed, as well as fibres and intercellular substance. Additional factors in the production of new connective-tissue cells are the *fibroblasts*, or certain cells found in the walls of the new arteries. But the process is not yet complete. What is formed is not *adult* connective tissue, but resembles *embryonal* connective tissue. It is always spoken of in connection with repair as *granulation tissue* (see below). The final stage consists simply in the *maturation* of this tissue until it becomes fully developed and of the "adult" type. The above phenomena greatly resemble the changes caused by a mild degree of inflammation, but they occur without bacteria or septic infection, hence are not "inflammatory."

Discuss the process of repair as it occurs in the different wounds.

In *incised wounds* whose edges have been approximated, the process of repair goes on as already described, except that as there is no loss of substance to be made up, but only union to be effected between two raw opposed surfaces, it is necessarily of very limited extent. In fact, it results in the formation simply of a very thin

layer, first of granulation tissue, and then of cicatricial tissue, between the two edges, for the entire depth, of the wound. When wounds are closed in this manner they are said to heal by *primary union* or *first intention*.

In *lacerated wounds* there is actual loss of substance to be made up; hence the process is extensive, and results in a mass of granulation tissue filling in the gap or cavity existing between the edges, which are more or less widely separated. This granulation tissue in lacerated wounds can be *seen*, and its surface is found to be not smooth, but covered with numberless little points resembling *granules* or granulations, whence its name. Furthermore, there is always an excess of white corpuscles in this process of repair in lacerated wounds, which appears on the surface of the granulations as *pus*. If the wound is being repaired or healing *aseptically*, this "pus" would scarcely be evident at all, and the discharge would apparently consist only of serum. But, owing to the difficulty of keeping such wounds aseptic, there is almost always an entrance of pyogenic bacteria, and hence an amount of suppurative inflammation, however slight it may be, is present, sufficient to produce the purulent discharge usually seen on the surface of wounds healing in this way. The wound is now an *ulcer*, and the last stage of repair consists in the *advancement of epithelium* from the surrounding skin *over* the surface of the granulations. Wounds closing in this manner are said to heal *by granulation*, or *second intention*. *Punctured* wounds also heal by "granulation."

What is healing by secondary union?

This is simply union effected by bringing together the edges of a wound whose surfaces are already covered with granulation tissue.

What is healing "under a scab"?

A wound starts in to heal by granulation in the usual way, but very soon there is formed on the surface a covering of coagulated blood, dried discharge, etc., which is called a *scab*. This scab stretches a little way beyond the edges of the wound, and *under it* the process of healing by granulation goes on to completion, including also the advancement of the epithelium.

Contusions are healed by granulation, the process being all the while, of course, covered in by unbroken skin.

Describe the process of repair in fractures.

It is exactly the same as already described, except, of course, the addition of *lime-salts* to what is first granulation tissue and later *bony-cicatricial* tissue, which bears the same relation to normal bone tissue as ordinary cicatricial tissue does to normal connective tissue. This bony-cicatricial tissue is called *callus*, and it forms in three places: (1) as a plug between the ends of the bones, extending from one medullary canal into the other; (2) between the opposed surfaces of the compact tissue; (3) beneath the periosteum on and along the superficial surface of the line of fracture. All this is *temporary* callus, and it becomes sufficiently hard to permit use of the limb in from six to eight weeks. The *permanent* callus is the permanent bony cicatrix into which the temporary callus in situations 2 and 3 (see above) becomes converted. This transformation takes from three to four months, during which time also the *medullary plug* of temporary callus is absorbed by physiological rarefying osteomyelitis (see Inflammations of Bone), and the continuity of the medullary canal is restored.

What is the process of repair in nerves?

If a nerve is divided, it may be possible to secure union at once between the divided ends. As a rule, however, the nervous elements of the entire distal section degenerate, and regeneration is effected by proliferation of nervous elements *from* the proximal section.

INFLAMMATION.

CLASSIFICATION AND VARIETIES.

What is inflammation?

Inflammation is an alteration in the structure of tissue accompanied by certain symptoms. This may be explained as follows: Any given area of tissue is made up of (1) *tissue-structure proper*, and (2) blood- and lymphatic vessels, which, for brevity, will be called the *vascular supply*. In health these two elements have a relationship to each other which is called *normal*, and which is based on the *amount* and the *condition* of each element present. This normal relationship varies, of course, in the different tissues. Hence anything which effects a variation in this normal relationship causes a change in tissue-structure, and this change, if accompanied by

certain symptoms, is called *inflammation*. On the other hand, if such a change is brought about by traumatism, it is called a contusion or a wound, each presenting its characteristic symptoms.

What are the different kinds of inflammation?

The change in tissue-structure already referred to may take place in one of two ways—viz. (1) by an alteration of the tissue-structure proper; (2) by an alteration of the vascular supply. In either case the amount or *quantity* and the condition or *quality* of each may be affected. Thus we may have a change in the *amount* of tissue proper—*i. e.* it may be increased or diminished; or its *quality* may be changed—*i. e.* a different *kind* of tissue may be substituted for the original tissue. Or the *vascular supply* may be increased or diminished by dilatation or contraction of the vessels, or the *quality* of the vessel-walls may be so altered that exudation of lymph or of one or other or of all the constituents of the blood is allowed. Therefore it follows that each of these changes corresponds to and is identical with a certain kind of inflammation.

These various inflammations are classified as follows: Inflammations of the tissue-structure proper are called *non-exudative* inflammations; those whose presence is shown by exudation of the blood-elements or of lymph are known as *exudative* inflammations; while to those which are characterized by increased or diminished vascular supply are given the names *hyperæmia* and *anæmia* respectively. It is understood of course that any one of these inflammations may occur either singly or associated with one or more varieties.

Explain more fully the non-exudative inflammations.

As already stated, these inflammations are changes in the tissue-structure proper. They are subdivided as follows: If the tissue is simply increased in amount, and at the same time retains its original characteristics, the inflammation is called *non-specific productive* inflammation. If, on the other hand, there has taken place a change in the *quality* of the original tissue, and a different kind of tissue of a certain definite structure has been substituted, the inflammation is called a *specific productive* inflammation. The terms “specific” and “non-specific” will be explained later on.

There remains that form of inflammation in which the tissue-structure is diminished or destroyed. This is called inflammation with the destruction of tissue, or “*destructive*” inflammation.

What can you say as to "destructive inflammation"?

"Destructive" inflammation is not of importance clinically, except as it occurs in conjunction with or secondary to other inflammations, such as productive, suppurative, or hemorrhagic. As just mentioned, the tissue-structure is diminished or destroyed, and this is in consequence of the presence of the primary inflammation, whose exudate, especially if it be suppurative, brings about by pressure the absorption and disappearance of the original elements of the part. A similar result is effected by the growth of tumors or by neuropathic influences. The best example is *rarefying osteomyelitis*. "Destructive" inflammation may even be physiological, as shown by the absorption of callus in the later stages of the repair of fractures. It will not be again considered, except by reference in connection with other inflammations.

Describe the exudative inflammations.

These are classified according to the character of the exudate, which may be lymph if from the lymphatic vessels alone, or if from the blood-vessels it may be plasma or serum or fibrin, or the white corpuscles or the red corpuscles, or a combination of any two or of all of these elements. From a clinical and surgical point of view there is no distinction made between inflammations whose exudate is lymph or plasma or serum. They are all called indifferently *serous* inflammations. If the exudate is fibrin, the inflammation is *fibrinous*; if the exudate consists of the white corpuscles, it is known as a *suppurative* inflammation and the exudate is *pus*. A secondary and contributory source of the pus-cells is probably the original connective-tissue cells of the part, which become thus altered and changed into pus-cells under the influence of the inflammatory action. There is also a certain amount of fluid in pus which is derived from the plasma of the blood, and is known as "pus-serum" or "liquor puris." Finally, if the red corpuscles predominate, the inflammation is called *hemorrhagic*, for the reason that, in addition to red corpuscles, more or less of the other elements of the blood are present in the exudate also.

Very often two or more of these varieties occur together; that is, the exudate is composed of two or more of the constituents of the blood. Thus there may be a *sero-fibrinous* inflammation; or one whose exudate consists of serum, fibrin, and pus, often called a *catarrhal* inflammation; or one in which the exudate is a mixture of considerable serum and some pus, and then the term *puru-*

lent is used as a designation. *Croupous* inflammation occurs on mucous-membrane surfaces, and the principal element of its exudate is fibrin, which, together with some pus-cells, epithelium, mucus, etc., forms an artificial membrane of greater or less extent.

The term "serum" is used purely in a surgical sense, and includes lymph, plasma, and serum proper.

Any of the exudative inflammations, *except* the suppurative and the purulent, may be either specific or non-specific (see Surgical Bacteriology), while the suppurative and purulent varieties are always non-specific.

What are hyperæmia and anæmia?

As already stated, these are the names given respectively to those varieties of inflammation in which the only changes are either an increased or a diminished blood-supply. Clinically, they are not regarded as varieties of inflammation at all, but as *symptoms* of one or the other regular inflammations. *Congestion* is a term often used to designate an increase of the *venous* blood-supply of a part, and *hyperæmia* then means an increase of the *arterial* blood-supply. All inflammations, whether exudative or non-exudative, are accompanied by more or less hyperæmia or anæmia as the case may be, and some may be *preceded* by either one or the other. With this understanding of these terms the conditions for which they stand will receive no further special consideration, and will be dropped from the list of regular inflammations.

Give a tabulated list of the principal varieties of inflammation.

Inflammations,	{	non-exudative,	{	productive,	{	non-specific.	
				“ destructive.”		specific.	
	{	exudative,	{	serous,	{	[specific.	
				fibrinous,		specific or non-	
				suppurative,		“	“
				hemorrhagic,		“	“
				sero-fibrinous,		“	“
				catarrhal,		“	“
				croupous,		“	“
				purulent,		“	“

This classification of inflammations is what may be called, in a gen-

eral way, an *anatomical* one, and is fundamental. Inflammation is thus to be regarded purely as a *local* process.

Are there any other ways in which these inflammations may be classified?

Each one of these inflammations presents, clinically, a set of symptoms, some of which are characteristic, while others are common to all. If these symptoms occur in a severe form and last but a comparatively short time, the inflammation is called *acute*. On the other hand, should the symptoms be of a milder type and continue for a comparatively long time, the process is known as *chronic*. Some of the inflammations are generally chronic, some are always acute, while others are sometimes acute and sometimes chronic.

Still another way of dividing inflammations is that based on their *causes*. These causes will be discussed in detail later on, but right here it may be stated, as an accepted fact to-day, that the *exciting* cause of all inflammations is *bacteria*. Now, as we shall see, the bacteria of inflammation are divided into two great classes the *specific* and the *non-specific* (these terms will be explained later). Hence the varieties of inflammation, as already given, may be grouped into two general classes—viz. the *specific* inflammations and the *non-specific* inflammations.

In *surgery* no other methods are used to classify inflammations than the three just given—viz. the *anatomical*, the *clinical* (acute and chronic), and the *bacteriological* (specific and non-specific). The terms “parenchymatous” and “interstitial” are often used in *medicine*. The former means an inflammation occurring in the *cells* or *parenchyma* of a viscus; the latter, an inflammation occurring in the *connective tissue* or *interstices* of a viscus.

Show the co-relation between the three ways of classifying inflammations.

An exudative inflammation—for example, the *suppurative* variety—is (generally) *acute* clinically and *non-specific* bacteriologically. Again, a serous inflammation may be acute or chronic, and may be specific or non-specific, as the case may be. And in like manner a *productive* inflammation may be acute, is generally chronic, and may be in its turn specific or non-specific.

How are these different varieties of inflammation named as they actually occur in the different tissues and organs of the body?

The suffix “itis” is applied to the Greek or Latin name of the

tissue or organ affected, and, when necessary for euphony, a slight change in the spelling of the new compound word is also made. For example: "inflammation of the pancreas" is *pancreatitis*; "inflammation of the joints" is *arthritis*, from *arthron*, a joint; *gastritis*, from *gaster*, a stomach; pharyngitis, pulmonitis, cellulitis, etc., etc. The last named is "inflammation of the connective tissues," and is derived from *cellula*, a cell. This method simply *locates* the inflammation, but does not give any information as to the *kind* of inflammation present.

For this purpose it is necessary to use certain qualifying adjectives, each of which shall represent one of the three ways of classifying inflammations. Thus, "acute suppurative arthritis" means an inflammation of a joint which is acute, non-specific, and whose exudate is pus (as we shall see later, *pus* is always non-specific); "chronic productive specific synovitis" means an inflammation of the synovial membrane which is "productive," and in which a different kind of tissue has been substituted for the original tissue of the membrane (already referred to under "Non-exudative Inflammations"). Hence it is "specific." But, practically, the *name* of the specific inflammation is sufficient. Thus, if it be tuberculosis or syphilis affecting the synovial membrane, the process is simply called *tubercular* or *syphilitic synovitis*, and as these are generally chronic, the term "chronic" may be omitted. One more example: If the synovial membrane should be affected by an exudative inflammation whose exudate is serous, it is a "serous synovitis." But this is not enough, because a "serous synovitis" may be acute or chronic, and if chronic it may be specific or non-specific. Thus, in the knee, "non-specific chronic serous synovitis" is the ordinary "water-on-the-knee" occurring after traumatism, while if it be one of the varieties of tubercular synovitis, then it is *specific*. This particular variety of tubercular synovitis would of course be an instance of a conjoined *exudative* and *productive* inflammation.

Is inflammation the only process by which a change in tissue-structure is brought about?

There are other processes, called *degenerations*, which effect a change in tissue-structure. They are, as a rule, of very slow course, and present few if any *direct* symptoms. These degenerations are really *depositions* in the tissue affected of material differing markedly in quality from the original tissue-structure, or they may be regarded, in some instances, as *transformations* of the original

tissue into this material, whatever it may be. They may occur primarily, but in general are secondary to some preceding inflammation. Their modes of origin are obscure, but are probably due to the alterations in the blood-supply caused by the preceding inflammation. If primary, then neuropathic conditions are doubtless important causative factors.

These degenerations are named from the *kind* of material produced. Thus:

Cheesy degeneration designates the material found in tissues which have been and are the sites of a tubercular inflammation.

Fatty degeneration is an abnormal deposit of fat.

Calcareous degeneration means the deposition of the salts of lime, etc. in parts originally the seat of an inflammation.

By *amyloid degeneration* is meant the transformation of the original tissue into an albuminous, wax-like material, formerly supposed to resemble starch in appearance, etc. etc.

ETIOLOGY OF INFLAMMATION.

What are the original causes of inflammation?

The original causes of inflammation, in a general way, may be divided into *mechanical*, *physical*, and *chemical*. Examples of each of these classes would be a blow, a cut, or the results of pressure (mechanical); the action of heat, cold, or electricity (physical); and the effect of acids or alkalies (chemical). In reality, then, *traumatism* of all kinds is the original cause of all inflammations. It must be understood, however, that traumatism in this sense has a very wide meaning, and includes not only *contusions*, but also *wounds* of all sizes, from the largest possible to microscopical. (The immediate effects of cold may be likened to a contusion of moderate severity.)

In some inflammations the influence of traumatism, however, is sometimes not clearly apparent. An example of such is *tubercular* inflammation. Here what is known as *heredity* might be said to play a rôle somewhat similar to that of traumatism in other inflammations. Other examples are *rheumatic* or *gouty* inflammations. In these certain states of the system which are called *diatheses* probably serve as original causes for the inflammation.

Traumatism, *heredity*, and the various *diatheses*, then, may be regarded as the *original*, predisposing or contributing, but *not* the *exciting*, causes of inflammation.

What is the exciting cause of inflammation?

The answer to this question is *bacteria*. That is, every inflammation is excited by the presence of bacteria, which either enter a wound from the air or are conveyed by the circulation to the site of a wound or contusion, or to a region rendered by one or other of the diatheses or heredity susceptible to bacteriological action. The statement that every inflammation is excited by bacteria does not mean that the bacteria of every inflammation have been actually demonstrated, but only that, bacteria having been shown to be the exciting causes of so very many inflammations, it may be assumed for practical purposes that they are the exciting causes of all inflammations.

Hence we see that for every inflammation *two* causes are required: first, either a *traumatism*, *heredity*, or a *diathesis* (of course traumatism may be *joined with* heredity or a diathesis); and secondly, the *presence of bacteria*. It thus seems to be necessary for the production of an inflammation that its locality be previously prepared either by traumatism, heredity, or a diathesis—in other words, converted into a *place of least resistance* (*locus minimæ resistantiæ*)—in order that the bacteria may act, since the presence of bacteria in the blood of persons suffering neither from traumatism nor any of the diatheses has been demonstrated, and has been productive of no harm. This presence of bacteria in the circulation explains how an inflammation may occur in contusions and in deeply-situated spots, access to which by bacteria directly from the air would be impossible. Finally, it must be remembered that traumatism is not *necessarily* followed by bacterial invasion and consequent inflammation, and that this fact is due to what is called the aseptic or antiseptic treatment of modern surgery.

Experimentally, it has been shown that certain varieties of traumatism, especially the chemical, can cause an inflammation without the aid of bacteria. But, clinically, this occurrence is so rare, if it ever happens, that it may be entirely disregarded.

We will now consider more in detail the subject of bacteria as the causes of inflammation. And in this connection it must be remembered that *inflammation* is not the *only* morbid process caused by bacteria. In other words, *putrefaction* is met with clinically as well as inflammation, and, similarly, is due to the presence of bacteria.

SURGICAL BACTERIOLOGY.*

What are the effects of vegetable parasites when introduced into the body?

All vegetable parasites, when introduced into the body and when surrounded by the proper conditions after such introduction, cause inflammation and other disturbances. This causation may be direct or indirect. If direct, then the presence and multiplication of the parasites themselves are considered as producing the inflammation or tissue-alteration. If indirect, then is the inflammation regarded as being due to certain alkaloidal substances produced by the action of the parasites (*bacteria*; see below) upon the elements of the tissues, especially the albuminous elements. The *indirect* method is probably the only way in which the true bacteria act.

What are these alkaloidal substances?

They are organic chemical compounds, and will be hereafter referred to briefly as "*products*." They comprise, in a general way, *ptomaines*, *leucomaines*, *toxalbumins*, *toxines*, *ferments*, etc.

All these classes of bacterial "*products*" are poisons, and hence the term "*septic*," or "*poisonous*," is applied to the diseases which they produce.

How are bacteria subdivided?

Of the three great divisions of vegetable parasites—viz. bacteria, yeasts, and moulds—the division embracing the *bacteria* is by far the most important surgically, because almost all the inflammations of which surgery treats are caused by parasites belonging to this class.

Bacteria are subdivided in two ways: 1. *Microscopically*, or according to their shape, size, aggregations, motions, etc.; 2. *Clinically*, or according to the *effects* they produce after introduction into the body. The second method is the only one we are here considering.

What is meant by the "effects"?

The *effects* referred to simply mean *symptoms*. These symptoms are—(1) *local*, or in and around the wound, contusion or point of infection itself; (2) *general*, or in the system at large. The local symptoms are of *two* kinds: (1) those of putrefaction; (2) those of inflammation. The *general* symptoms are of *three* kinds: (1st) those accompanying the putrefaction; (2d) those accompanying

* See *Preface*.

the inflammation; (3d) certain constitutional symptoms other than those due either to local putrefaction or to local inflammation, and which occur without any apparent local symptoms whatever. By "local" is always meant at the site of infection.

Before going on a definition of putrefaction is in order. Surgically, "putrefaction" means anything from the slightest degree of fermentation up to and including true chemical putrefaction. To proceed:

If each subdivision, then, of the above "symptoms" was caused by special bacteria, it is evident that we should have *five* classes of bacteria. But it is found that the bacteria which cause putrefaction and those which cause the general symptoms accompanying the putrefaction are the same. In like manner are the bacteria which produce the inflammation in and around the wound or contusion, and those which set up the general symptoms accompanying the inflammation, found to be identical. Thus we have *three* classes of bacteria: 1st, putrefactive bacteria; 2d, inflammatory bacteria; 3d, "constitutional" bacteria.

I. THE PUTREFACTIVE BACTERIA.

What are their local effects?

They always produce "putrefaction," of one sort or another, of the tissues surrounding the wound and of any discharges which may be in the wound. While causing this putrefaction they also form *products* (ptomaines). These "products" have nothing to do with the putrefaction. This is caused by the presence and multiplication of the bacteria themselves. The expression "always produce putrefaction" must be explained. Putrefactive bacteria never cause putrefaction in any wound the tissues of which possess any considerable degree of vitality. In other words, the wound-tissues must have been, previous to the entrance of these bacteria, rendered necrotic either by the injury or by inflammation. Otherwise, if they enter, they are simply carried away and have no effect. They are eliminated in the discharges from the wound. Finally, however, if these discharges are *excessive* and have not free exit, then these bacteria may, and often do, set up putrefaction in these discharges without necessarily affecting the tissues of the wound.

What are their general effects?

These are the general symptoms due to putrefaction, and are *not*

always present, even if, locally, "putrefaction" is going on. In other words, the putrefactive bacteria, while always causing putrefaction under the proper conditions, *may* or *may not* cause the *general* symptoms, as the case may be. But this causation, when operating, is never due to the bacteria themselves, but to their *products*. In other words, the general symptoms of putrefaction are always due to the effect on the system of these *products* absorbed from the wound into the general circulation, or, as happens sometimes, they may be absorbed through the mucous membrane of the alimentary canal, in this instance taking origin from more or less putrefying or decomposed intestinal contents (*intestinal toxæmia*). If these products are *not* thus absorbed, then there are *no* general symptoms of putrefaction. If the *bacteria themselves* are absorbed from the wound into the circulation, they die, and are excreted from the body *per vias naturales*, and do no harm. Furthermore, such bacteria may enter the circulation by absorption through the various mucous-membrane surfaces. If so, a similar fate awaits them, *unless they live long enough* to be carried to some focus whose tissues have been rendered sufficiently necrotic by traumatism or inflammation. If a lodgment is effected in this focus, putrefaction is set up, the resulting *ptomaines* are absorbed into the general circulation, and we have the general symptoms as before. Thus, the general symptoms of putrefaction never develop by themselves. In other words, the *products* of putrefactive bacteria must always be considered as having been derived from some spot, however small it may be, where the bacteria themselves have lodged, and where they are inducing a local putrefaction, however slight it may be. Thus we see that the putrefaction is caused by the bacteria, while the general symptoms are caused by the products of the bacteria.

What can you say as to their nomenclature?

Inasmuch as these putrefactive bacteria of *themselves* do no harm to the system, as we have seen, they are called *non-pathogenic* bacteria. This is the usual name for them, and is of course purely technical, and always, from a surgical point of view, means the bacteria of putrefaction and no other kind. They are also called "saprophytes" or *saprogenic bacteria*.

What may be said as to the nomenclature of their symptoms?

The term "septic" means poisonous. It is applied to the

diseases (and of course by the word *disease* we mean either—(1) a putrefaction or an inflammation occurring alone; (2) occurring in combination with constitutional symptoms; or (3) a group of constitutional symptoms occurring alone) produced by *all three classes* of bacteria. The term “non-infective” is technical, and is applied *only* to the diseases produced by the class of bacteria which we are now considering—viz. the *non-pathogenic* bacteria.

Thus, non-pathogenic bacteria produce *septic non-infective* diseases. The term “non-infective” is sometimes used synonymously with “non-pathogenic.” Bearing this in mind, it is well to avoid such a use of the word.

Do these diseases ever occur alone?

Clinically, these diseases never occur by *themselves*. They are always associated with other septic diseases caused by one or other or both of the remaining two classes of bacteria which we have not yet considered. Further than this, they are usually regarded as secondary to these “other diseases”—i. e. *inflammations*. So the patient is usually stated to be suffering from this “other disease” complicated *by* the putrefactive process. This statement does *not* mean that the “other septic diseases,” or the inflammations, are *always* complicated by the putrefactive process.

We do find, however, certain cases in which the putrefactive process is *much stronger* than the other disease. These cases are of two kinds: (1st) Those in which there are no general symptoms; example, certain forms of gangrene (there is always more or less inflammation surrounding the gangrenous area); (2d) Those in which there are general symptoms. In such cases we attribute these symptoms entirely to the absorption in the system of the *products* of the putrefactive bacteria, and we say that the patient is suffering from *septic intoxication*. Under certain forms of gangrene, then, and under septic intoxication, are grouped clinically all the septic non-infective diseases, or the diseases produced by all the different kinds of putrefactive or non-pathogenic bacteria. *Septic intoxication* will be considered more fully later on.

What can you say as to the different kinds of non-pathogenic bacteria?

They are very numerous, and are differentiated from each other, microscopically, by their size, shape, etc. Some of them cause only a very slight degree of fermentation, while others produce the most

offensive putrefaction. And still others give rise to degrees of "putrefaction" lying between these two extremes. The names of some of these are as follows: *Bacterium termo*, *micrococcus foetidus*, *bacillus gangrenæ*, *bacillus saprogenes*, etc. (note that the word "bacteria" has both a generic and a specific meaning). Thus most of the subdivisions of bacteria in general, as determined by the microscope, are found among these non-pathogenic bacteria just as they are found among the bacteria of the two remaining classes, which we will now take up.

II. THE INFLAMMATORY BACTERIA.

What are their local effects?

These bacteria produce inflammation, and this inflammation may be confined to the wound-tissues or may spread from them and involve other tissues as well. This inflammation, of whatever kind it may be, is *not* caused by the presence and multiplication of the bacteria themselves. But it is caused by the *products* (leucomaines) of these bacteria, which they begin to form right away after their entrance into any given spot. Thus we see one point of contrast between the way in which these bacteria produce their local effects and the way in which in their turn the non-pathogenic bacteria produce their local effects. The expression "always produce" requires an explanation similar to that given when discussing the non-pathogenic bacteria. In other words, "favorable conditions" are just as necessary for these bacteria to produce their effects as they are for the former. What are these conditions? They are innumerable, and probably vary for every individual, and certainly do vary for the different kinds of inflammatory bacteria, some causing inflammation under one set of conditions, while others under the same conditions do no harm. These conditions have already been referred to under "heredity" and "diatheses" in discussing the general etiology of inflammation. But, in any event, these bacteria must have *living* tissue to act upon, which is another point of contrast between them and those of the first class. And, similarly, they are carried away without causing any disturbance if they enter a wound whose tissues lack the "necessary conditions." The wound then heals by first intention.

What are their general effects?

These are the general or constitutional symptoms of inflammation, and, of course, are not always present even when a local inflamma-

tory process is going on. To produce these general symptoms it is necessary that these bacteria should leave the wound and get into the system at large; and not only that, but that they should form *new* products after such systemic introduction. These *new* products, then, formed *de novo* from the bacteria which have gotten into the blood, plus *probably* some of the original products absorbed from the wound, are the causes of the constitutional symptoms of inflammation. (This idea must not be confused with that of extension of the local inflammation to the neighboring tissues or to tissues more remote. These events, when occurring, are merely an *enlargement*, so to speak, of the local process, and are not necessarily accompanied by constitutional symptoms.) Note the fact that when the bacteria get into the circulation they do not set up any local inflammations as they go, although the same bacteria may have caused the original local inflammation. They cause only constitutional symptoms. (The *one* exception to this rule is pyæmia, which will be noticed later.) Also note that the *products* are the exciting cause both of the local inflammation and of the constitutional symptoms due to the inflammation, whereas under the non-pathogenic bacteria we see that the local process—*i. e.* putrefaction—is due to the bacteria themselves, and that the constitutional symptoms of putrefaction, when present, are due to the bacterial products *absorbed from the wound*, and are never caused by products made *de novo* from putrefactive bacteria in the blood.

What can be said as to their further nomenclature?

These bacteria are technically contrasted with the non-pathogenic bacteria, in that they are able to live and produce products in *living* tissue. Hence they are called *pathogenic* bacteria.

Describe the nomenclature of their symptoms.

The term “septic” is applied to the diseases of this class as well as to those of the other two classes of bacteria, while “infective” is applied only to the diseases of this class and of the class following. Thus, *pathogenic* bacteria produce septic infective diseases. The term “infective” is sometimes used synonymously with “pathogenic.” It is better to restrict its use solely to the diseases, and use “pathogenic” for the bacteria. We have seen that these bacteria may cause a local inflammation alone or may cause a local inflammation plus the constitutional symptoms of inflammation. If the former, then, as the case may be, the disease is spoken of as

a serous synovitis, or as a fibrinous peritonitis, or as a suppurative osteomyelitis or cellulitis.

If the *latter* (and constitutional symptoms may occur with *any* kind of a local inflammation, no matter where it may be situated), *then* the patient is said to be suffering from *septic infection*.

What can you say as to the different kinds of inflammatory bacteria?

Microscopically, they are divided, as usual, according to their shape, size, etc. But, *clinically*, the inflammatory bacteria are divided into *two* great subdivisions. This subdivision is based on the following observations: In the first place, it is found that certain of these inflammatory bacteria always cause the same disease, that they always reproduce this same disease after inoculation, and that they never cause any other disease. That is, that each kind of bacteria belonging to this subdivision always causes its own particular local inflammation, which may or may not be accompanied by constitutional symptoms, and never causes any other kind of inflammation. All the different kinds of inflammatory bacteria which act in this way, then, form the *first* subdivision, and the term *specific* is applied to them. Examples of the diseases which are caused by specific inflammatory bacteria, each of which is always, under the proper conditions, produced by its own bacteria, and never by any other kind of bacteria, are—erysipelas, tuberculosis, syphilis, gonorrhœa, actinomycosis, glanders, leprosy, etc. None of these produce *pus*. Now, the remaining inflammatory bacteria do not act in this way at all. In other words, you never can tell whether they are going to cause one kind of inflammation or another kind. It may be suppurative, or hemorrhagic, or serous, or fibrinous, or productive, or a combination of any of these. Hence the term *non-specific* is applied to those which form the *second* subdivision of inflammatory bacteria. Examples of the diseases caused by these non-specific bacteria are—*suppurative*: osteomyelitis, synovitis, peritonitis, cellulitis, myositis, teno-synovitis; *serous*: osteomyelitis, synovitis, peritonitis, cellulitis, myositis, teno-synovitis; *fibrinous*: synovitis, peritonitis; *variously* inflamed wounds, which are only local forms of cellulitis; *hemorrhagic* cellulitis, which embraces acute spreading traumatic gangrene, hospital gangrene, malignant œdema, etc.; also sinus, fistula, and ulcers, which are simply the results of various kinds of cellulitis, etc. In other words, all the *ordinary* forms of inflammation, no matter where

they are, are considered as being caused by the *non-specific* inflammatory bacteria. And, furthermore, remember that constitutional symptoms are always present with some of these diseases, and may or may not be present with others of them. And, finally, that any one of the *septic infective* diseases, whether *specific* or *non-specific*, may be acute or subacute or chronic. (The septic *non-infective* diseases take their course, and are acute or subacute or chronic, according to the acuteness or degree of chronicity of the septic infective disease with which they happen to be associated at the time.) As examples of the non-specific inflammatory bacteria may be instanced the different staphylococci and streptococci, the bacillus pyocyaneus, bacillus pyogenes foetidus, etc. etc. There are hosts of these bacteria. In a word, then, all the non-specific bacteria might, in a general way, be defined as the "pus-producing" (pyogenic) bacteria, which often cause inflammations other than suppurative.

A word more as to *symptoms*: If a patient has constitutional symptoms accompanying a local inflammation caused by either specific or non-specific inflammatory bacteria, he is said, as we have already seen, to suffer from *septic infection*. This is strictly correct, but, practically, this term is restricted more or less to describing the constitutional symptoms of some of the *specific* septic infective diseases, while to the constitutional symptoms of the *non-specific* septic infective diseases the term *ordinary septicæmia* or *septicæmia* is applied. And this is true whether the inflammation be suppurative, serous, or hemorrhagic, etc., or whether it be located in the connective tissues, in the joints, bones, serous cavities, etc. There is just one exception—viz. a certain non-specific suppurative inflammation which spreads in a metastatic manner and is accompanied by constitutional symptoms. This disease is always called *pyæmia*.

III. THE "CONSTITUTIONAL" BACTERIA.

What can you say as to their local effects?

They present no local symptoms, or, at all events, none that can be appreciated. They seem to leave the spot of inoculation or wound of entrance and spread at once into the system.

As to their general effects?

These are constitutional symptoms, occurring without any local symptoms, and in some instances they resemble the constitutional symptoms due to inflammation, but, as a rule, they are characteristic and differ from these. These symptoms are caused just as in

the preceding class; that is, by the *products* of bacteria derived from the bacteria while they are in the blood.

As to their further nomenclature ?

The same term, *pathogenic*, and for the same reason, is applied to these as to the inflammatory bacteria.

As to the nomenclature of their symptoms ?

These pathogenic bacteria set up *septic infective* diseases, just as in the preceding class. Similarly, patients who have these diseases are said to suffer from *septic infection*.

What are the different kinds of "constitutional" bacteria ?

Clinically, there are two classes, and this division is made precisely for the same reason as that which led to the division of the inflammatory bacteria. In other words, there are *specific* and *non-specific* constitutional bacteria. And these terms mean exactly what they meant when we were discussing them in connection with the inflammatory bacteria.

There are, surgically, comparatively few kinds of *specific* constitutional bacteria, those which produce tetanus and hydrophobia being the most prominent. The bacillus of the latter has not been discovered, but there is every reason to suppose that there is one.

In common parlance, patients with any one of these diseases are simply said to "have tetanus" or "hydrophobia," and the term "septic infection," though strictly correct, is not used. Of course the symptoms of each one of these diseases are characteristic, and do not resemble the constitutional symptoms of inflammation.

What may be said as to the non-specific constitutional bacteria ?

These are *the same bacteria* as the non-specific *inflammatory* bacteria; which means, simply, that there are times when these bacteria produce only *constitutional* symptoms, and have no *local* effect whatever at the "wound" or point of inoculation. Now, these constitutional symptoms are practically the same as the constitutional symptoms of inflammation, and in like manner, in any given case, these symptoms may not *all* be present, nor when present may they show the same degree of severity, etc. Thus we see that the term "non-specific" is just as applicable to these bacteria when acting in a "constitutional" manner as it is when they act in an "inflammatory" way. Patients, then, who have what we may now call the constitutional symptoms of inflammation without any local inflammation are said to be suffering from *true septicæmia*, which,

of course, is nothing but a kind of *septic infection*. Indeed, some speak of this "true septicæmia" as "true septic infection," in contrast to "ordinary septicæmia," which they call simply "septicæmia."

CLASSIFICATION OF BACTERIA.

Give the usual method of classifying bacteria.

As we have seen, the second and third classes of bacteria are each of them pathogenic, and, as we have also seen, in each of these classes there are both specific and non-specific bacteria. Furthermore, it has been made clear that *some* specific bacteria cause local inflammation with or without the constitutional symptoms of inflammation, and that *other* specific bacteria (*e. g.* tetanus) cause only certain constitutional symptoms without any local ones. This has also been shown to be true for the *non-specific* bacteria as well.

From this point of view, then, which differs only in the *grouping* of the bacteria of the second and third classes, we have the following *usual* method of classification :

		Diseases, Examples of—
1. Pathogenic.	Specific.	"Inflammatory." { 1. Erysipelas.
		2. Tuberculosis.
	"Constitutional."	3. Syphilis.
		1. Tetanus.
	Non-specific.	2. Tetany.
		3. Hydrophobia
2. Non-pathogenic or saprogenic.—	Specific.	1. All the usual local inflam- mations. If plus con- stitutional symptoms, then known as
		2. Ordinary sep- ticæmia.
	"Constitutional."	3. Pyæmia.
		1. True septicæ- mia.
	Non-specific.	1. Certain forms of gangrene.
		2. Septic intoxi- cation.

From the foregoing it is clear how inflammations may be divided into the *specific* and *non-specific* varieties, already referred to under Classification of Inflammations.

Define mixed and secondary infection.

(a) *Mixed Infection*.—This means that there are *two* processes, or even more, going on at the same time, and not only that, but that these processes probably began at the same time. For example, some cases of *erysipelas* begin to *suppurate* very soon; that is, a non-specific infection (pus) gets mixed in with a specific infection (*erysipelas*), or glanders may, and often does, present suppurating foci from the very beginning. When a marked interval of time occurs between the onset of the first disease and the supervention of the other, then we call it a case of (b) *Secondary infection*.

Any of the septic diseases, when pathogenic (specific or non-specific) or non-pathogenic, may complicate each other. This explains the presence of pus or other discharges in a tubercular or syphilitic process; also in the same way is explained the presence of putrefaction in a part which was previously undergoing a suppurative or serous or hemorrhagic inflammation; and in like manner the fact is made clear how a tubercular inflammation may take place in tissues previously thickened and altered by non-specific productive inflammation, etc. etc. Gonorrhœa is perhaps the best example of pure mixed infection, for it practically always has pus and its microbes from the beginning in addition to its own gonococcus. Finally, it is to be remembered that *all* inflammations, medical as well as surgical, can be brought under this classification and are susceptible of mixed or secondary infection; that the putrefactive processes or “diseases” are *always* accompanied by more or less inflammation of one kind or another; and that very many *inflammations* may have an accompanying putrefactive or fermentative process, slight or severe as the case may be, especially those inflammations whose exudate is copious and has not free drainage. Hence “ordinary septicæmia” may often be really a mixture of septic infection and septic intoxication.

SPECIAL VARIETIES OF INFLAMMATION.

Under this heading will be discussed briefly, and in a general way only, each of the various kinds of inflammation already referred to. The above Table of Classification will be followed.

What are the non-specific inflammations?

They are those inflammations which are caused by the *non-specific* pathogenic bacteria, and each one may be "exudative" or "productive."

What can you say as to non-specific productive inflammation?

This inflammation means simply an increase in the elements of the tissue-structure of the part affected and, in the viscera and various membranes, especially of their *connective-tissue* portions. (The purely pathological question as to whether, in such an inflammation, the *cells* or the *intercellular substance* or the *fibres* are increased or not, will not be discussed). It is common in the connective-tissue planes, in the female breast, in the joints, in the arteries, in the bones, and in the various viscera. Its symptoms vary according to its location. It may be primary, but it is generally secondary to one or other of the exudative inflammations. Its course is chronic as a rule, and its tendency is toward resolution after the subsidence of the primary inflammation.

What are the non-specific exudative inflammations?

These comprise the serous, the fibrinous, and the sero-fibrinous; the catarrhal and croupous; the suppurative and purulent; the hemorrhagic. The first three may occur in joints, in the peritoneum, and in the pleura. Of these, the *serous* may be present in any part of the body, and is a very common affection of the connective-tissue planes. The *catarrhal* variety is met with frequently in the joints as a synovitis. It is also very often found involving the mucous membranes, and then there is more or less mucus mixed with the exudate. *Croupous* inflammation is almost always situated on mucous membrane. *Suppuration*, or suppurative inflammation, may attack any organ in the body, the connective-tissue planes being a very common site. It is usually acute, but may be chronic. Certain varieties of pleuritis or of synovitis are *purulent*. But, practically, these may be regarded as mild forms of suppuration. *Hemorrhagic* inflammation occurring by itself is extremely rare surgically, because it is usually associated with *gangrene* or death of the tissues which it invades. For this reason it is called *gangrenous* inflammation. As met with commonly it is essentially an inflammation of the connective-tissue planes, involving in its course muscles, blood-vessels, and nerves according to its extent and severity. The same gangrenous inflammation at times affects the lungs, and, of course, may affect any portion of the body.

Hemorrhagic inflammation without gangrene is met with at times in the peritoneum, pleura, and pericardium.

What are the special or local symptoms of these non-specific exudative inflammations?

They vary according to the location and the variety of each. Hence we will postpone the discussion of the symptoms, treatment, special pathology, etc. of each of these inflammations until we meet it as actually occurring in some definite part of the body, as in the connective-tissue planes, the bones, the joints, etc.

What are the specific inflammations?

They are those inflammations which are caused by the *specific* pathogenic bacteria, and, like the non-specific, each may be "exudative" or "productive."

What may be said as to the specific exudative inflammations?

For purposes of clearness it may be said that the actual varieties comprise the same list exactly as was given of the non-specific exudative inflammations, with the exception of the suppurative and purulent. But, strictly speaking, each one of these specific exudative inflammations, as a rule and as met with clinically, should be regarded as a case of *mixed* or *secondary infection* (which see). In other words, the inflammation originally is specific—*i. e.* caused by a specific microbe—but sooner or later there are added non-specific bacteria, which aggravate and extend the process. This mixed infection, however, may not in some cases take place.

Give examples of specific exudative inflammations.

Specific serous inflammation occurs in the cellular layer and in and about the lymphatics of the skin as part of the lesion of *erysipelas*. Later on, suppuration may complicate the process. *Specific fibrinous* and *sero-fibrinous* inflammations are found in the serous and synovial membranes, in the former situations as part of the lesion of a tubercular peritonitis or pleuritis, and in the latter as partaking of the morbid condition of a tubercular, rheumatic, or gouty synovitis. *Specific catarrhal* inflammation is the essential lesion of gonorrhœal synovitis, as is *specific croupous* inflammation of diphtheria. *Specific hemorrhagic* inflammation is seen, surgically, in connection with gangrene or death of tissue in a manner precisely similar to that of *non-specific* hemorrhagic inflammation, and for a similar reason should be called *specific gangrenous* inflammation.

This is met with in *anthrax*, and in the rather rare form of erysipelas known as *erysipelas gangrenosum*.

What are the specific productive inflammations?

There are several special varieties of these, thus presenting a contrast to non-specific productive inflammation, which is practically always one and the same process.

Give examples.

Tubercular, syphilitic, and actinomycotic inflammations; also leprosy. The first three are commonly spoken of as tuberculosis, syphilis, and actinomycosis respectively. These four inflammations are primarily diseases of connective tissue, and will be dealt with more fully in speaking of the inflammations of the connective-tissue planes. They may occur in any part of the body, are usually primary, are chronic in course, and are generally of an unfavorable prognosis, actinomycosis being an exception in this last regard.

What are the special or local symptoms of the specific inflammations?

The consideration of symptoms, together with the special pathology, treatment, etc., of each inflammation, will be taken up later in discussing, under their several headings, the various tissues as affected by these inflammations.

SEPTIC INFECTION.

The above, in a general way, finishes the inflammations from a *local* standpoint. But on referring to the Table of the Classification of Bacteria we observe that there are, in addition to the inflammations, still other morbid processes to be considered which are also due to bacteriological action.

What are these processes, other than inflammations, due to bacteriological action?

They comprise two main classes—viz. 1, those due to *pathogenic* bacteria; 2, those due to *saprogenic* bacteria.

What are those due to the pathogenic bacteria?

They may be subdivided as follows:

(a) Certain constitutional diseases occurring without appreciable local symptoms;

(b) The *constitutional symptoms*, if present, of the various inflammations already discussed.

(The processes due to the *saprogenic* bacteria will be taken up later on under the heading of *Septic Intoxication*.)

What are (a) the constitutional diseases which occur without appreciable local symptoms?

As we have already seen, they in their turn are specific and non-specific. There is but one of the latter, and it is called "true septicæmia." The former comprise tetanus, tetany, and hydrophobia, and each will be treated presently in detail.

True septicæmia will be described more fully in connection with ordinary septicæmia, for the reason that its symptoms are practically the same, and that it differs only in the fact that there is no appreciable inflammation accompanying it.

What can you say as to (b) the constitutional symptoms of the inflammations?

These are the general symptoms which may accompany any one of the inflammations, whether it be specific or non-specific. If the latter, then the term "ordinary septicæmia" or "septicæmia" is used to designate the condition of the patient.

If the inflammation be *specific*, then the *name* of the disease is employed, although in every instance, of course, as already stated, the condition is really one of *septic infection*.

Each of the *chronic* specific inflammations has its own fairly characteristic general symptoms (tuberculosis, syphilis, myxœdema, etc.), which will be referred to in the discussion of each as it occurs in the different regions of the body. The same may be said of the general symptoms of the *acute* specific inflammations, although, especially in erysipelas, their resemblance to *septicæmia* is very great.

Finally, before taking up *septicæmia* in detail, two things must be understood—viz. (1) That *all* the symptoms of septicæmia are not necessarily present in any one case of inflammation. and also that there may be great variation in the severity of those symptoms which are present; (2) that, in speaking, farther along, of "constitutional or general symptoms" in connection with any one of the non-specific inflammations, no matter where its locality may be—in the connective-tissue planes, in the bones, the joints, the peritoneum, the pleura, the brain, or anywhere—we mean the patient is suffering from *ordinary septicæmia*. Of course in the brain there

are other "general symptoms," due entirely to cerebral compression, and having nothing in common with the septicæmic process.

SEPTICÆMIA.

What is septicæmia?

Septicæmia is a variety of septic infection, and is characterized by certain constitutional symptoms. Its etiology has already been sufficiently discussed, but it may be well to sum it up as follows: Septicæmia is the name given to an abnormal condition of the general system which is manifested by certain constitutional symptoms, and is due to the absorption into the vital centres of the body of the *products* of the *non-specific pathogenic* bacteria. The *primary source* of these products may be either (*a*) the blood in general, or (*b*) an inflammation. If the former alone, then we have a condition of *true* septicæmia; if the latter, the condition is called *ordinary* septicæmia. But it must be borne in mind that even in ordinary septicæmia, after it is well established, the blood in general is infected by new products formed *de novo* by bacteria in the blood, as well as by the constant absorption of products and bacteria from the local inflammation. Thus the presence or absence of a *local* inflammation is the only difference between ordinary and true septicæmia.

In true septicæmia how does the blood in general become infected?

By the entrance of bacteria into a wound, which may be very large or even microscopical in size. Then an invasion of the blood by these bacteria through the lymphatics takes place, and they begin to form their products, which are absorbed by the vital centres, and the symptoms of true septicæmia are developed.

What is the condition of the wound in true septicæmia?

If microscopical in size, it is naturally of no account. If of appreciable extent, the wound is rather dry and of a somewhat glazed appearance, and the surrounding tissues may be slightly swollen. Or there may be simply capillary oozing. No signs of true inflammation are present. Or the wound may appear perfectly healthy.

What are the symptoms of true septicæmia?

They are the same as those of a severe type of ordinary septicæmia. They last but a few days, and terminate usually in the

death of the patient. Otherwise—which is a rare outcome—recovery may be rapid and immediate, provided the process has remained a true septicæmia, and no local inflammation has arisen, for in the latter instance ordinary septicæmia would supervene.

What is the treatment of true septicæmia?

If a wound is present, treat it as if an inflammation were also present—that is, antiseptically. The constitutional treatment is also that of ordinary septicæmia.

What is ordinary septicæmia?

Ordinary septicæmia is that variety of septicæmia which is caused, in the manner already mentioned, by a non-specific inflammation. This inflammation is invariably one of the exudative varieties, as non-specific *productive* inflammation practically never causes the symptoms of septicæmia.

What inflammation most commonly produces ordinary septicæmia?

Suppurative inflammation, and it makes no difference where its locality may be. The other varieties of the exudative inflammations except hemorrhagic in like manner may induce symptoms of septicæmia, but, as a rule, the severity of the symptoms is much less. The symptoms of typical ordinary septicæmia are best seen when caused by suppurative inflammation.

What are the symptoms of ordinary septicæmia?

They may appear either simultaneously with the onset of the local inflammation or not until a day or two afterward. A pronounced chill is usually the first symptom, and this is followed by fever of a continuous type; that is, it runs high all the time from 102°–104°. Prostration and mental apathy are marked, the latter alternating with delirium. There may be headache. The pulse is firm, and runs about 120 beats to the minute. Vomiting and diarrhœa are often present. The skin is hot and dry and pale or ashy-gray in color; later it may become yellowish, but the sclerotic is always white. There may be pains in bones, joints, and muscles; also hyperæsthesia. The lymphatic glands all over the body are enlarged, and especially the spleen. An eruption may occur resembling that of scarlet fever. The urine is scanty and with a large percentage of urates. The tongue is covered with a dry, whitish crust, but the borders may be red. These symptoms may terminate fatally in twelve hours. More frequently, however, they last for three or four days, when the symptoms of collapse from exhaus-

tion supervene, and the patient dies on the sixth or seventh day from the beginning of the attack.

What is the prognosis of ordinary septicæmia?

If of a severe type and left without treatment, a fatal result is to be expected. If properly treated, even severe cases have a fair chance of recovery. The milder forms, caused by exudative inflammations other than suppurative, and hemorrhagic are naturally of a much more favorable prognosis, and very often end in recovery without any treatment at all. Such mild types may present only a slight rise of temperature, with some headache and general malaise. The treatment should be the same, practically, as that for severe cases. The severest type of ordinary septicæmia is that due to *gangrenous* inflammation, and its prognosis is almost uniformly fatal.

The mild types of septicæmia referred to above may of course result from the presence of exudative inflammations other than suppurative (*i. e.* "serous") in *regular wounds* of *appreciable size*. Fever may be a prominent symptom (102° F.). Such forms of septicæmia are often spoken of as "traumatic" or "septic traumatic" or "surgical" fever if the wound is made in an operation. Again, the term "secondary wound fever" is frequently used to designate that form of septicæmia which results from a *suppurative* inflammation occurring in a wound similar to the above. Such terms are undoubtedly confusing, and it is better to regard simply as varieties of septicæmia (ordinary) *all* forms of constitutional disturbance which are due to the non-specific inflammations, no matter whether these inflammations begin "idiopathically"—*i. e.* without an appreciable local lesion—or whether they have their starting-point in the tissues surrounding a regular wound, either accidental or operative.

What is the treatment of ordinary septicæmia?

The main treatment is, of course, that of the causative inflammation, and the details of this treatment will be given later on, when considering each of the various inflammations as it occurs in the different regions of the body. Suffice it to say here that if the causative inflammation is an abscess or a diffuse suppurative cellulitis, a free incision must be made and thorough drainage established. And the same may be said for this inflammation wherever its site—*i. e.* bones, joints, muscles, pleura, peritoneum, liver, etc. If the inflammation has started in a *wound which has been sutured*,

then all sutures should be removed and all recesses containing pent-up exudation be drained. If the wound be an *open one*, it should be kept open, and the same search and care for "pockets" or recesses be carried out.

The after-treatment consists in the application of absorbent gauze, both in the form of strips for packing the wound and as compresses applied about the wound, the gauze being thoroughly soaked in some antiseptic solution.

If the causative inflammation is one which is not suppurative nor gangrenous, the same treatment is indicated, except that in some instances, where there is no appreciable *wound*, an incision may not be necessary and the inflammation subsides under the application of antiseptic solutions.

If the inflammation is gangrenous, nothing but the prompt removal of the affected area, by amputation when possible, will save the patient.

The *constitutional* treatment is simply the free use of cardiac stimulants and a liquid diet. Of the stimulants, those for steady use are of course brandy or whiskey, while strychnine, atropine, strophanthus, or digitalis may be relied upon for occasional administration. As to diet, beef-tea and milk are the principal forms of nourishment, but this question is of course entirely dependent upon the state of the stomach, and if nausea and vomiting be present these should be treated on general principles. Antipyretics should not be used. They depress the heart and do no real good.

What are the post-mortem changes in septicæmia?

The various viscera are swollen, and their parenchyma shows minute spots of necrosis. The spleen is enlarged and soft. The lymphatics show signs of inflammation. There is neither embolism nor thrombosis in the blood-vessels. The blood is black, does not coagulate, and contains pus-microbes. The capillaries are inflamed, and on their walls microbes are seen. Hemorrhages under the skin and the mucous and serous membranes are found.

What is pyæmia?

Pyæmia is that form of ordinary septicæmia which is characterized by the formation of *multiple foci of suppurative inflammation* (metastatic abscesses), either simultaneously or consecutively, in various parts of the body, and by the accompaniment of certain constitutional symptoms.

What is the etiology of pyæmia?

Pyæmia is due to the action of the pus-microbes (non-specific pathogenic bacteria), just as is septicæmia. But in the latter, as we have seen, the microbes, after leaving the original focus of inflammation, proceed through the system *without* causing suppuration as they go. But in pyæmia, on the contrary, after a similar invasion of the system, groups of these bacteria become lodged in various regions, and there set up foci of suppurative inflammation.

Why this peculiar result should occur is not clearly understood. One explanation given is that in pyæmia there is not such a general and even distribution of the microbes throughout the blood as there is in septicæmia, but that they occur in masses or groups held together in each case by an embolus of red or white blood-corpuscles, and in consequence of this massing they have more power to set up a suppurative inflammation in whatever tissue they may become lodged. This power is doubtless augmented by the actual injury to the vessel-wall caused by the embolus. This idea secures support from the fact that post-mortem examinations of pyæmic patients show more or less extensive thrombi in the veins, especially the veins leading from the site of the original inflammation, and also emboli blocking the terminal arteries of the regions in which are found the different foci of new suppuration. Furthermore, these thrombi and emboli are found to contain bacteria. Thus in a general way it may be said that in *pyæmia* the *blood* becomes *directly infected* by means of the *veins*, while in *septicæmia* the *blood-infection* is by the more *indirect route* of the *lymphatics*.

Another explanation is that of a specific microbe for pyæmia acting in conjunction with the pus-microbes. But this is pure theory, as no microbes have been found in pyæmia except those of the regular pyogenic variety.

What is the causative inflammation of pyæmia?

Almost always suppurative, and at times gangrenous, but never any of the milder forms of exudative inflammation. Furthermore, the original point of infection, as in ordinary septicæmia, *may* set up an inflammation either independently of any wound of appreciable size or in a previously existing wound. Similarly, it makes no difference as to the *site* of the original inflammation.

What are the symptoms of pyæmia ?

First of all, from a diagnostic point of view, must be considered the *metastatic abscesses*. If these do not occur or are not observed, then a positive diagnosis of pyæmia cannot be made.

The other symptoms resemble those of septicæmia, except in the following particulars : The fever is *always* preceded by a *very severe chill*, which may last from a few minutes to an hour or more, during which time the *fever* comes on. This, instead of being continuously high, as in septicæmia, is of an intermittent type ; that is, it falls almost or quite to normal, and then rises again, but between these two extremes there are always more or less remissions. The height may be 105° F. The fever continues for several hours before the intermission occurs, which is marked by a profuse *perspiration*. These three symptoms, chill, fever, and perspiration, form a cycle, as it were, and according to the severity of the attack there may be two or three or more occurrences of these cycles during the twenty-four hours. The *mind is clear*, as a rule, throughout the disease, though delirium has been observed in some cases. The *skin is yellow*, the color being due to the disintegration of the coloring matter of the red blood-corpuscles which have been destroyed. Occasionally this icterus may be a true jaundice. Pus and albumen in the urine indicate the involvement of the kidneys in the pyæmic process. The general aspect of the disease at first greatly resembles malaria, with which it may be confounded. The symptoms of pyæmia complicating a wound usually appear during the second week after receipt of the injury and after suppuration in the wound has become well established.

What is the appearance of the original wound in pyæmia ?

Originally the site, as a rule, of a suppurative inflammation, after the pyæmic process has become well established the wound shows marked changes both in the character and quantity of the pus, which becomes scanty and more or less mixed with serum. The granulations are pale and flabby, the wound-edges are œdematous, and there may be some capillary hemorrhage. Gangrenous inflammation may then ensue, or in some cases the wound may have been the site of a gangrenous inflammation from the beginning.

What may be said as to the metastatic abscesses ?

These may occur in any organ or part of the body—the lungs, liver, spleen, kidneys, pleura, peritoneum, bones, joints, brain, and

connective-tissue planes. They may be very small, "miliary abscesses," and only demonstrable after death: such abscesses are found very often in the substance of the valves of the heart. The formation of a metastatic abscess is usually indicated by symptoms referable to and significant of the part involved.

What are the post-mortem changes of pyæmia?

Serous effusion is often present in the peritoneal and pleural cavities. Abscesses, large and miliary, are found almost everywhere. Infarctions in the solid viscera are common. Thrombi are met with in the veins, especially those near to and leading from the site of the original inflammation. Emboli are discovered in the smaller arteries, which also show signs of having been the seat of a suppurative arteritis.

What is the prognosis of pyæmia?

If the site of the original inflammation be accessible to prompt treatment, this fact greatly favors the chances of recovery. But in any event acute pyæmia is nearly always fatal. The course is about one week or ten days. Fairly frequently some cases of pyæmia become chronic and last for weeks, with recovery in a few instances.

The *symptoms* of chronic pyæmia are practically those of the acute form, but of much less severity. The intervals between the cycles of chills, fever, and perspiration may be several hours or even half a day, and the fever may not rise above 103° F.

What is the treatment of pyæmia?

The best is of course preventative, which simply means the utmost care in carrying out the details of antiseptic wound-treatment. The active treatment is the same as that for septicæmia, and in addition the metastatic abscesses must be opened and drained as soon as they form.

What is septico-pyæmia?

This is rather rare. It is a mixture of septicæmia and pyæmia. It may occur in one of three forms: (a) cases of *clinical septicæmia* die, and the autopsy shows minute abscesses scattered throughout the viscera; (b) cases which show the *symptoms of septicæmia*, and also have the regular *metastatic abscesses*; (c) cases which present the usual *symptoms of pyæmia*, but *without* apparent *metastatic abscesses*. This last group is exceedingly rare, and the autopsy

would doubtless demonstrate miliary abscesses. In some cases it has done so, while in others no autopsy was held.

What is chronic septicæmia?

Certain cases of acute suppuration, even after treatment, do not get well, and sinuses form and constantly discharge pus. Locally, this process is known as chronic suppuration. At times these cases also show constitutional symptoms, such as persistent fever at night (102° F.), which disappears in the morning; night-sweats, emaciation, rapid and feeble pulse, enlargements of the lymphatic glands, and amyloid degeneration of the kidneys and other viscera. This condition is *chronic septicæmia*, or the "hectic fever" of older authors. The *prognosis* is bad, and *treatment* is drainage and maintenance of the general strength. Very often such cases are complicated by *tubercular* inflammation, and are examples of mixed infection.

SPECIFIC CONSTITUTIONAL DISEASES OCCURRING WITHOUT APPRECIABLE LOCAL SYMPTOMS.

Under this heading will be considered *tetanus*, *tetany*, and *hydrophobia*.

What is tetanus?

Tetanus is a specific septic-infective disease which has no appreciable local symptoms, and is characterized by spasms of certain groups of muscles.

What is meant by "no local symptoms"?

This means no symptoms of inflammation *referable to the point* of infection or inoculation, which "point" may be a lesion, microscopical in size, of the skin or mucous membrane, or perhaps more often a regular wound.

What is the appearance of the wound in tetanus?

There may be no inflammatory changes. Usually, however, it is the site of a suppurative inflammation, but may, of course, show signs of the presence of any of the exudative inflammations. And in all cases this inflammation is due not to the tetanus microbes, but to the regular inflammatory bacteria, which have infected the wound simultaneously with, or previous to, or possibly after, the entrance of the tetanus microbes. Obviously, the patient may thus be suffering from ordinary septicæmia in addition to tetanus.

What is the cause of tetanus?

A specific microbe, the *bacillus tetani*. This was discovered in earth by Nicolaier, and by Rosenbach in pus from a wound of a patient suffering from tetanus. As to the mode of action of these bacilli of tetanus, it is the same as that of the regular pathogenic bacteria; that is, they enter the blood and form chemical products which are absorbed by the vital centres and cause the symptoms of tetanus. The centres in the brain and spinal cord appear to be those which are especially affected by these poisonous products of the tetanus bacillus. This bacillus is found not only in the exudate of the local inflammation, but in the tissues and in the blood. This presence of the bacillus in the blood is denied by some authorities, who claim that tetanus is not a *septic-infective* disease, but that it belongs to that class of septic *non-infective* diseases which are embraced under the head of *septic intoxication*. From this point of view the tetanus bacillus would be "non-pathogenic" or "saprogenic," and only its products, *ptomaines*, would be absorbed into the blood from the wound, and the presence of these alone would cause the symptoms. However this may be, three of these "ptomaines" have been isolated, and to each has been given the name *tetanin*, *tetano-toxin*, and *spasmo-toxin* respectively. These poisons act on the central nervous system in a manner greatly resembling that of strychnine. The chief habitat of the tetanus bacillus is the soil.

What are the symptoms of acute tetanus?

These develop at a time varying from twenty-four hours to several weeks after the receipt of the infection. The first one is a feeling of soreness and stiffness in the muscles of the neck and *mastication*, which is soon followed by a *distinct* and *painful spasm* of the latter group of muscles. This is *trismus*, and in a general way is diagnostic, as it is the first pronounced symptom of tetanus, and is absent in hydrophobia and strychnine-poisoning. Then follow in rapid succession painful spasms of the muscles of the back of the neck, of the back, of the chest, and of the abdomen, while the muscles of deglutition may or may not be affected. Thus the head, neck, and spinal column are violently bent backward (*opisthotonus*), there is extreme difficulty in respiration, and the abdominal walls are tense and rigid. In some cases, however, the spasm of the anterior trunk-muscles is sufficient to overcome that of the spinal muscles, and in consequence the body is bent forward on

itself (*emprosthotonus*). The facial muscles are now attacked, giving the characteristic *grin* or *risus sardonicus*. The lower extremities may become rigid, but the upper limbs are unaffected. According to the severity of the attack these spasms follow each other in more or less rapid succession, and in severe cases death from exhaustion, preceded by the symptoms of collapse, occurs in from one to three days. There are intervals between these spasms, but these same muscles are always rigid. There is never any *complete relaxation*, such as occurs in the intervals between the spasms of strychnine-poisoning. The mind is usually clear, and the temperature rises somewhat, and may reach 103° F. During an "interval" the slightest cause, as the opening of a door, a draught of air, the sudden entrance of light, etc., may bring on a spasm.

What is chronic tetanus?

This is simply a mild form of acute tetanus, in which the muscular spasms are comparatively slight, and the "intervals" are long and marked by complete relaxation. This form may last for weeks, with a fair chance of recovery. Chronic tetanus may also be preceded by an attack of acute tetanus. This is rare, however, as the latter usually terminates in death at the end of the fifth day at the latest. Should the patient survive an attack of acute tetanus for more than five days, then the disease gradually becomes chronic and the prognosis is more favorable.

What other clinical varieties of tetanus are there?

Tetanus hydrophobicus and *tetanus neonatorum*. The former is sometimes called "head tetanus." It follows injuries to the head, especially wounds of the face. Its symptoms are trismus, paralysis of the facial nerve on the side of the injury, and difficulty in deglutition. In this last symptom it resembles hydrophobia; hence its name.

Prognosis fairly good.

Tetanus neonatorum, or of the new-born, occurs during the first week after birth. The umbilicus is the site of the infection. It is uniformly fatal.

There are no pathological changes found post-mortem in any of the forms of tetanus which may be said to be characteristic. In some cases hyperæmia of the medulla and cord has been observed, also some softening of the gray matter of the cord.

What is the treatment of tetanus?

The wound should receive careful antiseptic treatment. If of very minute size, it should be located if possible, and freely incised and drained. The constitutional treatment consists in isolating the patient and in having the room as dark and quiet as possible. Chloral hydrate and potassium bromide should be administered in large doses and at frequent intervals. Chloroform or nitrite of amyl are useful during very severe spasms. Nutrition should be carefully attended to, by enemata when necessary. Cures have been reported recently by Italian surgeons, who have used hypodermic injections of *antitoxin*, a substance obtained from rabbits and other animals which have been previously inoculated with tetanus bacilli or their ptomaines. A very free use of iodoform in the wound has also been well spoken of.

What is tetany?

This, like tetanus, is a specific septic-infective disease unaccompanied by any special local symptoms, and characterized by spasms of certain groups of muscles. The bacillus has not yet been discovered. It may occur "idiopathically;" that is, with a wound of microscopic size. It also may come on after entire removal of the thyroid gland. Young persons are those principally affected.

What are the symptoms of tetany?

Painful tonic spasms of the flexor muscles of the hands and feet. In many cases the knee and elbow are also flexed. Sometimes there is opisthotonus. Respiration is difficult and cyanosis is present. There is no trismus. These spasms last from half an hour to two hours, and during the intervals there is complete relaxation.

What is Trousseau's test for tetany?

During an interval between the spasms pressure on a nerve will reproduce the spasms.

What is the pathology of tetany?

There is nothing characteristic. In some fatal cases the autopsy has shown a swelling of the cells in the gray matter of the anterior cornua of the cord, together with some atrophy of the cell-nuclei and processes.

The *prognosis* is good, and the *treatment*, similar to that of tetanus, is based on general principles.

What is hydrophobia?

Hydrophobia is a specific septic-infective disease, of which the wound or point of inoculation may not be apparent, and which is always accompanied by convulsions of various groups of muscles.

What is the exciting cause of hydrophobia?

Undoubtedly a specific microbe, although its actual presence has not yet been demonstrated. Hence in speaking of the cause of hydrophobia the word *virus* is used instead of *microbe*. This virus is found in the saliva of animals, especially dogs and kindred species, which are suffering from rabies. Hence the most common "original" cause of hydrophobia is a wound inflicted by the bite of such an animal. And yet an actual bite is not necessary to produce the disease. But in such a case a pre-existing wound, however small it may be, is necessary, and it must come in contact with saliva containing the virus. This virus is not confined to the saliva, but it is also found in the blood and interstitial fluids. Hence the need of great care in examining the bodies, men or animals, of those who have died from hydrophobia. All bites of rabid animals do not necessarily cause hydrophobia. Thus bites inflicted on parts protected by clothing are less dangerous, because the saliva is apt to have been wiped from the teeth.

What is the prognosis of hydrophobia?

It is always fatal. No real case of hydrophobia in man has ever recovered. Patients, however, have escaped hydrophobia who have actually been bitten by genuinely rabid animals even in parts unprotected by clothing. Such escape was due, in all probability, only to the promptest local treatment.

The *duration* of the disease is from twelve hours to six days, the average being about three days.

What are the symptoms of hydrophobia?

These do not occur until about six weeks after the date of infection, and in the mean time the wound has healed. This is the so-called stage of incubation, which may last as long as eight months. During "incubation" the patient feels perfectly well. Then for about twenty-four or forty-eight hours before the onset of the regular symptoms there is a feeling of general malaise, accompanied by headache, sleeplessness, and anxiety. The eicatrix

of the wound may or may not become tender and reddened. The regular symptoms now come on, and consist of a series of "attacks," each "attack" being made up of muscular spasms, the first of which is a spasm of the muscles of *deglutition*. This is rapidly followed by difficulty in respiration, due to spasmodic action of the *laryngeal* muscles. Thick saliva forms in the pharynx and pours from the mouth. General convulsions now ensue. Sometimes the spasms of the trunk-muscles resemble those of tetanus, but in all cases there are intervals of *complete relaxation* between the attacks. Each paroxysm lasts about half an hour, generally less and rarely longer. There may be delirium, but always intense mental excitement and anxiety. Hallucinations are fairly frequent. The temperature runs from 100°–103° F., and with a corresponding pulse. After a day or two the symptoms of collapse from exhaustion appear, and the patient dies. Sometimes the condition of collapse is accompanied by a rapidly-ascending paralysis.

The *pathological* conditions are similar to those of tetanus.

What is the treatment of hydrophobia?

Hydrophobia, when well developed, admits of no especial treatment; that is, with the idea of curing the patient. All that can be done is to relieve the spasms by such measures as have already been advised in the general treatment of *tetanus*.

Prophylactic treatment is the only one which offers any chance of recovery. In applying this there are two procedures to be adopted—viz. (a) immediate local treatment of the wound; to be followed by (b) Pasteur's treatment. The first is absolutely necessary, and consists in thorough excision of the tissues around the wound or the free application of the actual cautery. Caustic potash or fuming nitric acid may be used. The subsequent handling of the wound should be by the open method. If for any reason the bite cannot be attended to at once, the parts on the cardiac side should, if possible, be tightly constricted, and kept so until excision or cauterization has been employed. In fact, such constriction should perhaps be made in any event before doing anything else.

The Pasteur treatment, or the method by inoculation with emulsions made from the dried spinal cords of rabbits previously infected with, and which have died from, rabies, should be instituted as soon as possible after receipt of the injury. This statement doubtless reflects the views of a majority of the authorities on the subject.

On the other hand, equally competent observers have declared the Pasteur treatment to be unsafe, and as likely in itself to cause hydrophobia or fatal septicæmia.

SEPTIC INTOXICATION.

By referring once more to the Table of the Classification of Bacteria we observe that there still remain to be considered the morbid processes due to the action of the *saprogenic* bacteria.

How may these processes be subdivided ?

As already stated, the saprogenic bacteria (saprophytes) may act in a purely local manner without constitutional symptoms, or such local action may be accompanied by constitutional symptoms. Clinically, there is no example of a disease, due to saprogenic bacteria, manifesting itself *only* by constitutional symptoms; that is, the saprogenic bacteria do not cause any diseases which are the analogues of true septicæmia, tetanus, or hydrophobia.

What are the processes due to the local action alone of the saphrophytes ?

In a word, these are the processes of *putrefaction* of varying degrees of severity which occur in (a) certain forms of gangrene; (b) the discharges of any of the exudative inflammations, usually the suppurative or serous varieties.

Explain the above more fully.

Gangrene does not necessarily mean putrefaction. Gangrene is death of tissue, and could we exclude the saprogenic bacteria from any given area of gangrene, there would be no putrefaction. But this is impossible; hence, sooner or later, all forms of gangrene become infected with saprophytes, with resulting "putrefaction." Of course the *degree* of this putrefaction may be limited by proper treatment.

Now, *certain forms* of gangrene, such as the traumatic and those varieties due primarily to disturbances of the arterial or venous circulation, often occur with a *minimum* amount of surrounding inflammation, and with no constitutional symptoms. And it is *these* forms of gangrene, after putrefaction has set in, that constitute one division of the "local processes" of the saprogenic bacteria.

The other division comprises putrefaction occurring in *inflammatory exudates* of all varieties. Thus the discharges from a wound

which is the site of a suppurative inflammation may collect in pockets and recesses and become putrefied. Or a focus of inflammation (suppurative or serous) may open spontaneously or be incised, and the discharge will have a bad odor, due to decomposition caused by the saprophytes. In both of these instances there are supposed to be no constitutional symptoms present. Retained blood-clots may also putrefy.

What are the processes due to saprogenic bacteria and accompanied by constitutional symptoms?

These are all known as varieties of *septic intoxication*, and will be at once taken up in detail.

What is septic intoxication?

Septic intoxication is an abnormal condition of the general system manifested by certain symptoms, and due to the absorption, by the vital centres of the body, of the *ptomaines* of the saprogenic bacteria. And these ptomaines, as has already been stated, are taken into the blood *from the wound* or other point of putrefaction or fermentation, wherever that may be.

What are the two main varieties of septic intoxication?

Fermentation fever and *sapraemia*. The former is also called aseptic fever or primary wound-fever.

Describe fermentation fever.

This is the mildest form of septic intoxication. It occurs at times with wounds that have been made during an operation, and which have received the most careful aseptic treatment. It is rarely met with under other circumstances, except occasionally in simple fractures. There are no symptoms other than fever and a corresponding rise in the pulse-rate. The fever comes on a few hours after the completion of the operation, runs rather high (102° F. on an average), and disappears at the end of forty-eight hours, and the patient feels perfectly well in the mean time.

What is the condition of the wound?

It is that of all wounds which are healing by primary union. There is no inflammation present.

What are the causes of fermentation fever?

Although the wound is healing by primary union, there is still enough exudation and molecular necrotic tissue present in and on the opposed surfaces to form a focus for a mild fermentative action

of certain saprophytic bacteria which have gained access to the spot. And it is to the absorption of certain ferments, notably fibrin-ferment, which are the results of this fermentative action, that this fermentation fever is due.

What is the treatment?

There is no treatment for the fever itself, save watching for a day or two for the symptoms of septicæmia. The wound should be left alone. A mild purge may be given. Preventative measures consist in careful stoppage of all hemorrhage at the time of the closing of the wound, for the reason that bloody discharge, if retained, is a very favorable medium for the action of these saprophytes.

What is sapræmia?

Sapræmia is that form of septic intoxication in which there are marked constitutional symptoms and a more or less severe local putrefactive process.

What are the general symptoms of sapræmia?

They are practically those of septicæmia. A differential diagnosis based on symptoms alone could not be made. If the case is severe, then all the symptoms are present; if less severe, then some may be present and others not, etc., just as in the case of septicæmia.

Mention some of the local putrefactive processes which cause sapræmia.

Any gangrenous inflammation, such as noma, anthrax, acute spreading traumatic gangrene, malignant œdema, etc. In these cases we really have a mixture of septicæmia and sapræmia, because, locally, we have both an inflammation and a putrefactive process. Again, psoas abscesses frequently, if not always, have a foul odor; hence showing the presence of saprophytes. Here we have an instance of a *suppurative* inflammation combined with putrefaction of its exudate, and in like manner the general symptoms of psoas abscess are really due to both septicæmia and sapræmia. Examples of *pure* sapræmia are never met with, for the reason that, clinically, all foci of putrefaction have more or less inflammation of the surrounding tissues, and of course it is doubtful how much the bacteria of this inflammation contribute to cause the constitutional symptoms. However, there are cases in which we can disregard this accompanying inflammation, and practically call

them *sapræmia*. Examples: A *hæmatoma* is sometimes conjoined with severe general symptoms. On opening the swelling the retained blood is found to be decomposed and possessing a very bad odor. Similarly, certain forms of "puerperal fever" are due to decomposed fragments of placenta and blood-clots remaining in the uterine cavity. To conclude: The only positive way of making a *clinical* diagnosis of *sapræmia* is by the sense of *smell*. The amount of bad odor in any given focus determines the degree of putrefaction. If the odor is very bad and the inflammation slight, it is *sapræmia*; if with a bad odor there is present considerable inflammation, the case is one of *sapræmia* and *septicæmia* combined; and if the odor is slight or absent and the amount of inflammation considerable, then the constitutional symptoms are to be regarded as due to *septicæmia* alone. *Pyæmia*, of course, may be similarly complicated with *sapræmia*.

What is intestinal toxæmia?

It is that form of *sapræmia* in which the focus of putrefaction is located in a mass of decomposing fæces, and from which the ptomaines are absorbed into the system through the intestinal mucous membrane. Marked general symptoms may thus be produced. Hence the importance of having the bowels well cleared, and of always inquiring into their condition whenever the patient's temperature rises.

What is the treatment of *sapræmia*?

Local and general, and on exactly the same lines as already laid down for that of *septicæmia*. There is a point to be noticed in this connection—viz. other things being equal, the constitutional symptoms of *sapræmia* subside much more quickly after thorough drainage of the point of local disturbance than do those of *septicæmia*. The reason is that the ptomaines, being manufactured only on the spot, are carried off, and thus the system is relieved of the infection; while in *septicæmia*, it will be remembered, the pathogenic bacteria form their leucomaines not only on the spot, but also in the system at large. Hence a longer time is required for elimination, and recovery.

DISEASES OF THE CONNECTIVE-TISSUE PLANES.

What are the inflammations of the connective-tissue planes?

They comprise two main divisions, specific and non-specific. Of the *specific* inflammations we have erysipelas, anthrax, glanders, tuberculosis, syphilis, actinomycosis, myxœdema, and leprosy. The *non-specific* are serous, suppurative, and gangrenous inflammations.

The *non-specific* group will be considered first.

Describe suppurative inflammation of the connective-tissue planes.

This occurs in one of two ways—viz. diffuse and circumscribed. If the former is present, the process is called simply *suppurative cellulitis*; if the latter, the term *abscess* is used. Hence an abscess is really a circumscribed suppurative cellulitis. An abscess may be acute or chronic.

The above of course refers to “idiopathic” suppurative cellulitis, or that variety which occurs without any visible traumatism. Suppuration occurring in *wounds* is the same process. In fact, a wound which is suppurating may be regarded as an abscess with the incision already made.

What is the pathology of an acute abscess?

As a result of any one of the “original” causes of inflammation already discussed, one or more of the varieties of the staphylococci set up a focus of suppurative inflammation in a given region of the connective-tissue planes. This process continues, more and more pus accumulates, and the “abscess” enlarges in the direction of least resistance. Accompanying this process is, of course, actual destruction of the elements of the original connective tissue, or a “destructive inflammation,” and this occupies an area immediately surrounding the pus. Beyond this is still another zone of connective tissue which is more or less thickened, and which, as the pus accumulates, in its turn breaks down or becomes the seat of a “destructive inflammation.” This thickened zone means merely that a “productive” inflammation has taken place, and it constitutes the so-called “wall” of the abscess. The inner portion of this zone, before it breaks down, is changed into granulation tissue. This is the name given to connective tissue in the adult when its structure is the same as that of connective tissue in the embryo. In the *process of repair* (which see) there is, speaking in a general way only, first, loss of tissue; secondly, granulation tissue;

and, lastly, fully-formed tissue. Conversely, in the process of destruction we have first normal tissue, which, after becoming somewhat thickened, is changed to granulation tissue, which in its turn is destroyed.

Finally, if left to itself the pus reaches the skin, which in like manner becomes first thickened and then destroyed; the pus escapes, and the abscess is said to have "opened spontaneously."

What is the pathology of a chronic abscess?

Occasionally a regular non-specific abscess is met with which is chronic; that is, certain symptoms are absent which are found accompanying an acute abscess. The pathology of such an abscess is the same as that already given.

Usually, however, a chronic abscess is an example of "mixed infection;" that is, suppurative inflammation has been *added to or set up in* a focus of a preceding specific inflammation, which, in the great majority of cases, is *tubercular*, but may be *syphilitic*. In such abscesses the process differs from the foregoing only in the following respects: If the original inflammation is tubercular, then the "thickened zone" is largely made up of, and infiltrated by, tubercular tissue, and the surface of this zone, which is in contact with the pus, is covered by a layer of this same tubercular tissue, often called "gray-granulation" tissue. This layer may be quite thick, and if so constitutes the "pyogenic membrane" of some authors. Furthermore, the pus contains the detritus of this layer as it breaks down, together with the tubercle bacilli.

If the original inflammation is syphilitic, the new tissue is naturally that due to the influence of the syphilitic virus, but the "pyogenic membrane" is much less marked.

Of course a tubercular or syphilitic focus may be infected by *acute* suppuration.

Finally, after opening such a chronic abscess, almost always there will be found a sinus leading from its cavity to either an area of tubercular bone-inflammation or one or more tubercular lymphatic glands.

What are the symptoms of an acute abscess?

Pain, swelling, heat, and redness of the skin, tenderness, fluctuation, and impaired function of the part in which the abscess is situated. If the abscess is deeply placed, *fluctuation* may not be detected. The other symptoms of course vary in degree and severity.

The *constitutional* symptoms, which simply indicate the presence and which *are* those of ordinary septicæmia, may or may not be present, though, as a rule, we find them. The *course* of an acute abscess—that is, the time which elapses from its formation until it “breaks”—varies from a few days to a week, or even two weeks. No abscess should be allowed to run this course, but should be treated as soon as the diagnosis is made. Great destruction of surrounding parts is always apt to follow the growth of an abscess, and even death may result from its rupture into the trachea, a large vein, or an artery.

What are the symptoms of a chronic abscess?

If non-specific, there are simply *swelling* and *fluctuation*, and the course may be very slow. If preceded by a focus of specific inflammation, we have the corresponding symptoms of that inflammation.

What is the treatment of an acute abscess?

Incision and drainage. The direction of the former should, as a rule, be made to conform with that of the long axis of the body. If the abscess is deeply seated, a series of incisions should be made, the first one severing the skin, and the others the various layers of subjacent tissue, until the pus is reached. Sometimes the incision becomes quite deep and no pus is evacuated. An aspirating needle should then be inserted, and, if pus is found, the knife may be at once plunged in the direction of the needle, and the pus allowed to flow out. As it comes it should be taken up on a sponge. The finger is now placed in the abscess-cavity to determine its extent and the necessity of enlarging the incision, which should always be as long as the largest diameter of the cavity. Irrigation now follows with a warm solution of bichloride of mercury (1 : 5000) or of carbolic acid (1 : 60) or any antiseptic solution, after which the cavity is packed with a long strip of iodoform gauze. The usual *after-dressing* for wounds follows. If the abscess is superficially placed, it may be incised at once by plunging the knife directly into it through all the overlying tissues. The incision is then enlarged by drawing the knife upward and downward. It is not necessary to scrape the walls of an acute abscess. In all abscesses the skin should be previously made aseptic. (See Treatment of Wounds.)

What is the treatment of a chronic abscess?

The same as the above, except it be large and of tubercular origin. In such a case it may be simply aspirated and pressure applied; or the contents may be evacuated through a small incision and drainage-tubes inserted; or a comparatively large incision may be made and the walls carefully scraped, this to be followed by irrigation and drainage either with tubes or iodoform-gauze packing.

Describe suppurative cellulitis.

This is diffuse suppurative inflammation of the connective-tissue planes, and is usually located beneath the deep fascia of the part affected. Although an acute process, the degree of its severity and extent varies greatly. The *general* symptoms are those of a severe or mild septicæmia, as the case may be. The *local* symptoms are those of an acute abscess, except that the swelling is naturally much more spread out. In severe cases the pus may extend from the ankle to the knee or from the palm of the hand to the elbow. There is also, almost always, involvement both of the neighboring and distant lymphatic glands. Thus the axillary glands are often swollen if the forearm is inflamed. As to etiology, the bacteria are usually of the variety known as streptococci.

What is the treatment of suppurative cellulitis?

Occasionally one or more large incisions are required. Usually, however, a number of small incisions is sufficient. In all cases these incisions should be carried *through* the deep fascia. Hence the importance of sponging the blood out of the first cut, and thus exposing the fascia clearly to view. The after-treatment is the same as that of acute abscess. Sometimes, however, the iodoform-gauze packing may be replaced by a packing of gauze soaked in bichloride solution (1 : 5000) or carbolic acid (1 : 60), or creolin, 2 per cent., or acetate of aluminum, saturated solution. Over the incisions and entire surface of the part should then be placed gauze compresses soaked in the same solution, and held in place by a gauze bandage similarly moistened. The entire dressing should be kept wet by pouring on some of the same antiseptic fluid every hour or two. This treatment should be kept up for forty-eight hours, when iodoform packing and dry dressing may be substituted.

If for any reason, either with an acute abscess or a suppurative

cellulitis, it is impracticable to incise at once, the *pain* may be mitigated by the application of poultices, the use of which, however, should not last over twenty-four hours at the outside. The best poultice is several thicknesses of gauze soaked in an antiseptic solution and covered by a layer of rubber tissue, over which a few turns of a bandage are placed. This should of course constantly be kept wet.

Wet dressings are better for inflammations which are still active. Suppurative cellulitis, as a rule, remains active for a day or so even after the incisions have been made. On the contrary, the activity of an abscess, as a rule, seems to subside at once after the incision. Hence the difference in the first dressing of each.

What is chronic suppuration of the connective-tissue planes?

This is the process which goes on, sometimes, in an abscess-cavity which does not heal. The recurrence of this is rare after an acute abscess.

Suppurative cellulitis may also become "chronic" after the incisions have been made. This is also a form of chronic suppuration. Or, in neglected cases both of abscess and cellulitis, the pus may have opened spontaneously and continued to discharge for days, or even weeks, before coming under observation.

The *treatment* for chronic suppuration is stimulating; that is, the pus-cavities or tracts should be scraped and packed with gauze soaked in balsam of Peru or in a solution of zinc sulphate, gr. 2½ to aq. 3j. This same treatment may also be used to advantage in acute suppurative processes after a few days of the iodoform packing.

What is a carbuncle?

A *carbuncle* is at first a more or less circumscribed area of sero-fibrinous cellulitis of the cellular tissue immediately beneath the skin, which is also soon involved in the process. In a very short time, within a day or two, in this area a *number of abscesses* are formed which break through the skin. Thus, in its full development, a carbuncle is a patch of thick, red, brawny skin, punctured, so to speak, with the orifices of these broken abscesses, out of which pus and sloughy tissue are discharged. The margin of the carbuncle is fairly well defined, and there is a tendency to spread as well as to a coalescence of the various abscesses by breaking down of intervening cellular and cutaneous tissues. Constitutional symptoms (septicæmia) are severe, and the prognosis is very grave,

especially in elderly people, who seem particularly liable. The back of the neck and between the scapulæ are favorite sites.

What is the treatment of carbuncles?

In vigorous persons a complete excision of the area, if not too extensive, is indicated. Otherwise, the entire mass should be laid freely open with a crucial incision. In either event the usual antiseptic dressings are applied. In enfeebled persons such procedures are not indicated, as *gangrene* may result. All that can be done is to make from time to time small incisions and irrigate with peroxide of hydrogen or other antiseptic fluid. The system should be supported on the most generous diet the stomach can stand.

Describe serous cellulitis.

This is serous or sero-fibrinous inflammation of the connective-tissue planes. Like suppuration, it may occur in a diffuse or circumscribed form. If in the *latter*, it is the analogue of an abscess, and the term "phlegmon" may be used as a designation.

The *symptoms* of each of the varieties of serous cellulitis resemble those of the corresponding form of suppurative cellulitis, except that they are less marked. The symptoms of septicæmia are slight or absent. The process is almost always acute. If untreated, the inflammation is apt to run into the corresponding form of suppuration. In fact, phlegmon very often cannot be distinguished from abscess until the incision shows only blood and serum in the discharge. This is the proper treatment, however, so, practically, an error in diagnosis of this sort makes no difference. The same may be said of diffuse serous cellulitis. However, if the diagnosis is clear and the case is seen early, an immediate incision is not necessary, and a wet dressing applied over the part for twenty-four hours will, in many cases, effect a cure. This same process may of course occur in the *tissues of a wound*, and should receive the same treatment.

What is acute teno-synovitis?

This is really a sero-fibrinous cellulitis limited to the delicate layers of connective tissue immediately surrounding the muscles and tendons, and not, as its name implies, an inflammation of the synovial sheaths of the tendons, for, although the process may begin in these latter, it always extends far beyond their limits. Its most common site is the muscles of the forearm. It is usually caused by strain or over-use.

What are the symptoms?

Those of a mild degree of regular cellulitis, and, in addition, the characteristic *crackling* or *crepitation* obtained on palpation while the patient moves the muscles. *Pain* is also a prominent symptom.

The *treatment* is rest. The forearm should be wrapped in ordinary cotton, and the wrist immobilized by a light wooden splint. A cure is usually to be expected by the end of a week. At times the pain and crepitation continue for weeks, and then, and then only, should counter-irritants be used, such as iodine, blisters, or the actual cautery. Septicæmia is rarely, if ever, present.

Suppurative cellulitis and *ordinary* septicæmia are often caused by "*dissection*" wounds, while *pure* septicæmia may result from wounds received while making an *autopsy*. The latter is much more serious.

What is gangrenous cellulitis?

This is that form of cellulitis in which the exudate is hemorrhagic, and its severity is such that death of tissue ensues from its presence. This death of tissue is one of the forms of "gangrene." Gangrenous cellulitis may infect the tissues of a wound, it may supervene on a suppurative cellulitis, or it may occur, more rarely, as practically an idiopathic process. In all cases, though, more or less true suppuration is present also. It may remain limited, but usually extends rapidly, involving all structures—muscles, vessels, nerves, etc.—in its course, and thus producing masses of dead, sloughy tissue. There are various names given to gangrenous cellulitis, which are really superfluous and somewhat misleading, such as "acute spreading traumatic gangrene," "local traumatic gangrene," etc., the word "traumatic" being especially unnecessary, for two reasons: viz. true traumatism does not cause this form of inflammation directly, any more than it does any other form; and, secondly, there is a true "traumatic gangrene" with which the idea of inflammation must not be associated.

What are the symptoms of gangrenous cellulitis?

Following and then blending with the symptoms of suppurative cellulitis we have hemorrhagic œdema of the tissues, soon followed by their death. The skin is darkly discolored, and the epidermis is raised in blebs. In front of the advancing inflammation the tissues which are about to be attacked are swollen and brawny, and the skin is of a reddish color. Rarely the process stops of itself, and death usually ensues within two or three days if the case is

left untreated. Even with prompt treatment the prognosis is grave. A fluid of pus, serum, and blood permeates the dead tissue everywhere, and gives a feeling of boggiess and almost fluctuation. Very soon after the process begins there are also signs of putrefaction, such as bad odor and greenish color. This means, of course, that the saprogenic bacteria have infected the part in addition to those of gangrenous cellulitis—*i. e.* the staphylo- and streptococci.

Following the bites of certain snakes, gangrenous cellulitis may at once develop without any previous suppuration.

What is the treatment of gangrenous cellulitis?

Immediate incision and evacuation of all pent-up discharges and removal of all dead tissue. This is followed by an antiseptic dressing of gauze, as before described, or balsam of Peru may be used. If the process is still advancing at the end of twenty-four hours, then nothing but amputation well into healthy tissue should be attempted. If the trunk, head, or neck is the part affected, then complete excision of the gangrenous area is indicated. Some cases require *immediate* amputation or excision.

What are the general symptoms of gangrenous cellulitis?

They are those of the severest form of ordinary septicæmia combined with those of sapræmia, this last being due to the presence of the saprogenic bacteria.

The *treatment* has already been indicated under Septicæmia.

What is noma?

Noma is the name given to gangrenous cellulitis of the cheek. Its origin is, as a rule, on the mucous membrane. It usually occurs in ill-nourished children or in those recovering from scarlatina. The whole cheek may be destroyed.

The *treatment* of removal of the gangrenous area by the actual cautery is recommended. The defect in the cheek should be closed by a plastic operation, but not until there is complete cessation of the inflammation and cicatrization is complete.

What other forms of gangrenous cellulitis are there?

Malignant œdema and hospital gangrene.

The *former*, known also as "gangrenous emphysema" and "fulminating gangrene" (gangrene foudroyante), is simply an extremely severe form of gangrenous cellulitis, accompanied by a

development of gas, which increases the swelling and causes a fine crepitation to be felt on pressure of the skin. This gas is a product of a special saprogenic bacteria called the bacillus of malignant oedema.

The *latter* is of rare occurrence now-a-days. It attacks operative wounds, especially those of amputations. It is of somewhat slower course than ordinary gangrenous cellulitis, but its tendency to spread is decided. Chiefly characteristic, however, is the layer of decomposed pulpy tissue which forms on the wound-surfaces, and which also covers in the newly-ulcerated surfaces caused by the spread of the inflammation to new tissue. Decomposition is marked and the discharge is fetid.

Marked septicæmia and sapræmia are present in both these forms, of which the *treatment* is the same as already indicated.

What are sinus and fistula?

A *sinus* is a pocket in the tissues with a blind extremity and an external opening. It is usually of narrow calibre throughout, but its blind extremity is often dilated to form a considerable cavity. The walls of a sinus are always lined by granulation tissue, and pus is constantly discharged. Suppurative inflammation, either occurring primarily or infecting a previous focus of specific (tubercular or syphilitic) inflammation, is the usual cause of a sinus. An abscess which opens spontaneously becomes a dilated sinus. Similarly, sinuses are formed by the pus of a suppurative cellulitis burrowing in various directions and finally breaking through the skin.

A *fistula* is simply a sinus with *two* openings, usually with one in the skin and the other in the mucous membrane. It has the same causes. Or there may be a fistula between two hollow viscera, such as the bladder and vagina. In this case, of course, there would be no proper *wall* of the fistula. The "wall" would be simply the *edge* or border of the opening.

What is the treatment of sinus and fistula?

Sinus: Scrape out thoroughly and pack with gauze soaked in balsam of Peru or other stimulant. If this fails, then the sinus must be completely laid open with the knife, scraped with a sharp spoon, and the resulting wound packed to the bottom with balsam-of-Peru gauze. Sometimes it is indicated to close the wound by sutures, and thus obtain primary union. Very often, however, a sinus tends to recur unless it is packed after being split open.

Fistula: Same treatment as above, except in special varieties, such as vesico-vaginal fistula, which require a plastic operation.

What is ulceration?

Ulceration is the process by which a "destructive inflammation" causes loss of substance of the skin or mucous membrane. The area from which the tissue has thus been removed is called an *ulcer*. An ulcer differs from a sinus, then, only in being spread out, as it were, over a flat surface, instead of being a cavity with walls. The *floor* of an ulcer corresponds to the *walls* of a sinus, and, similarly, is covered with granulation tissue, and for the same reason. (See "Sinus" and "Pathology of Acute Abscess.") Thus we see that granulation tissue represents an *intermediate stage* in two processes: one of *retrogression*, from fully-formed tissue to absolute loss of tissue; the other of *progression*, from loss of tissue due to traumatism to fully-formed tissue. This last is the "process of repair" (q. v.), and is not regarded as a true inflammation, although it must be confessed that the distinction is somewhat arbitrary. Inasmuch as *traumatism* may cause loss of substance of the skin or mucous membrane, it is clear that as the process of repair sets in we shall soon have, instead of the original wound of the skin, an area whose floor is covered by granulation tissue. This area is also called an *ulcer*.

What are the varieties of ulcer? What is the definition of ulcer?

From the preceding paragraph it is evident that there are two main varieties of ulcer—one due to "ulceration," and the other due to traumatism. The former will be called "*pathological*" *ulcers*, and the latter "*traumatic*" *ulcers*. And, as each kind has granulation tissue on its floor, an ulcer may be defined as a flat area of granulation tissue situated on the skin or mucous membrane, and due primarily to traumatism or to pathological conditions. The *quality* of the granulation tissue of each of these ulcers differs, because one represents retrogression and the other progression. Hence the treatment of a pathological ulcer is based on the endeavor to reverse the process and to convert its granulation tissue into one of such quality that it will cicatrize rather than constantly break down.

How may pathological ulcers be subdivided?

According to their causes. The *immediate* cause, as just stated,

is "destructive inflammation." But this is always secondary to a preceding exudative or productive inflammation, to the growth of tumors, or to an abnormal condition of the trophic nerves of the affected part. It may therefore be disregarded as a clinical etiological factor. Hence, clinically, pathological ulcers are caused by *inflammation, tumors, and neuropathic disturbances.*

Describe the ulcers of inflammation.

Just as inflammations are divided, so are these ulcers, into specific and non-specific. The specific ulcers are those due to tuberculosis, syphilis, etc. The non-specific are the result of the various forms of non-specific inflammations of the skin (or mucous membrane) and subjacent tissue, as well as of inflammation of the arteries and veins of the part. Thus we have tubercular and syphilitic ulcers, eczematous and varicose ulcers (due to varicose veins), etc.

What are the "neuropathic" ulcers?

These are due to certain states of the nervous system whereby the trophic nerves of a part become diseased in a manner not clearly understood. The result is that certain patches of skin become discolored and rapidly break down. No history of traumatism or inflammation is obtainable in these cases, which require general tonic treatment, electricity, etc. in addition to local treatment.

What are the ulcers due to tumors?

These, clinically, are not true ulcers, but are regarded simply as tumors which have broken through the skin or mucous membrane, as the case may be. These ulcers, in the vast majority of the cases, are due to the malignant tumors—*i. e.* carcinoma and sarcoma. Thorough removal is the only treatment.

What are some characteristics of all ulcers?

All ulcers, whether traumatic or pathological, have a floor and an edge. If the granulation tissue on the *floor* is red, not particularly elevated, and presents a fine granular surface, and if the edge slopes gradually up to the skin-level and has a bluish tinge, the ulcer is known as a "healthy" ulcer. If, on the other hand, the granulation tissue is pale, flabby, and redundant, and if the edge is perpendicular and of hard texture, the term "callous" or "indolent" ulcer is employed. If pain is marked, then the ulcer is called "painful" or "irritable." If a tendency to spread is shown, it is a "phagedenic ulcer." Rodent ulcer is an ulcerated epithelioma of the skin. Any ulcer may have any of these characteristics.

What is the treatment of ulcers?

As a rule, all forms of specific ulcers should be excised, except those due to syphilis, for the *treatment* of which see the volume of this series on *Genito-urinary and Venereal Diseases*.

For non-specific and traumatic ulcers the treatment is as follows, and of course varies with the condition of the ulcer: For exuberant granulations a thorough application of a stick of silver nitrate should be made. If the edge is thick, as it usually is with large granulations, narrow strips ($\frac{1}{2}$ inch) of adhesive plaster, sufficiently long to extend well on to the healthy skin, should be heated in the flame of an alcohol lamp, and then placed firmly, overlapping each other, right on the ulcer. Then gauze and cotton should be put over these strips and carefully bandaged. This treatment should be made every other day. It is probably the best all-around treatment for ordinary ulcers.

If an ulcer is very "callous," thorough scraping of the floor and edge with a sharp spoon, or actual excision of the edge with a knife, followed by an iodoform-gauze dressing, is necessary. This should be followed in a few days or a week by the use of adhesive plaster or "strapping" in the manner already referred to. Should there be much inflammation of the skin and surrounding tissues, apply a wet dressing for a day or so. Sometimes the various ointments are of service before using the adhesive plaster, such as of ichthyol, iodoform, zinc oxide, boric acid, etc., of an average strength of 10 per cent., but the boric acid may be as strong as 30 or 40 per cent. If varicose veins are present, an elastic stocking or rubber bandage is of advantage. Finally, the cure of a "healthy" ulcer is often hastened by skin-grafting.

Describe briefly Thiersch's method of skin-grafting.

The grafts, taken preferably from the same individual, are cut by a sawing motion of a razor laid flat on the part (anterior surface of thigh) from which the grafts are obtained. Each graft is made as large as is necessary, and consists only of the upper layers of the skin. An ordinary salt solution (boiling water allowed to cool, 1000; ordinary salt, 6) is kept trickling over the razor while the cutting is going on. The ulcer to be grafted is lightly scraped, the surrounding skin having been previously rendered aseptic, and the grafts are placed on its surface, their edges just touching each other. Narrow strips of rubber tissue are now laid, with interspaces, over the grafts, and the whole enveloped in gauze wet with

the salt solution. The dressing is removed and renewed in three or four days.

What are the effects of a burn ?

According to the degree of severity we may have—1, hyperæmia of the skin ; 2, a superficial dermatitis, resulting in the formation of vesicles and bullæ ; 3, immediate destruction of the epidermis ; 4, a deep dermatitis, resulting in sloughs and destruction of the entire skin of the part ; 5, immediate destruction of the entire skin, together with more or less of the underlying tissues. Extensive burns are very fatal. Probably the best way to treat these is by the *permanent bath*, or the burns may be kept covered with Fuller's earth or lycopodium or oxide-of-zinc powder. Burns covering a limited area may be dressed with weak iodoform or carbolic vaseline, or with one of the above-mentioned powders, or with Carron oil (an emulsion of olive oil and sodium bicarbonate). Vesicles and bullæ should be evacuated and the *epidermis allowed to remain*.

Scalds are burns made with hot liquids.

What is a frost-bite ?

This is a local hyperæmia or a local non-suppurative cellulodermatitis induced by exposure to *cold*. The severest form of frost-bite is simply a variety of traumatic gangrene induced by cold.

Treatment of these varietics is on general principles, care being taken, however, *not* to warm the parts too soon by *direct heat*.

What is ingrowing toe-nail ?

As usually seen, this condition affects the nail of the great toe and on its inner side. It may affect both sides simultaneously. It consists in a curving of the nail toward the plantar surface in such a manner as to *cut into* the adjacent soft parts. More or less local cellulitis is present, together with pain and discomfort in walking.

What is the treatment ?

Slice off *all* the soft parts flush with the side of the nail, so as to leave a raw surface extending from a level with the base of the nail to the end of the toe, and whose *entire plane equals* the dorso-plantar diameter of the toe and looks directly inward. The curved portion of the nail is then cut off and the surface allowed to heal by granulation (Cotting).

Or this same amount of soft tissue may be formed as a *lateral*

flap, base upward, which is sutured in place after removal of the redundant portion of the nail with the part of the matrix belonging to it (Anger).

The *specific* inflammations of the connective-tissue planes will now be considered. Of these, tuberculosis, syphilis, actinomycosis, myxœdema, and leprosy are usually *chronic*.

What is tuberculosis?

Tuberculosis is the name given to a general disease which causes in the tissues a tubercular inflammation, which is specific, productive, and usually chronic. Tubercular inflammation always affects connective tissue, and the process is essentially one by which a tissue of new formation (tubercle tissue) takes the place of the original normal tissue.

Where does tuberculosis occur?

This inflammation may take place in the *connective-tissue elements* of any organ or structure in the body. It is very common in the bones. Its occurrence in the gross connective-tissue planes as a primary inflammation is, however, extremely rare. Such an occurrence is usually secondary to, and is an extension from, a neighboring area of tubercular inflammation in a bone or lymphatic gland. Furthermore, such a focus of tubercular cellulitis (as it should be called) has, by the time it comes under observation, usually become infected by the pus-microbes, and a condition of chronic or "cold" abscess exists. In some cases, however, the contents of such an abscess do not reveal, under the microscope, the presence of any pus-microbes nor that of true white blood-corpuscles. The place of the latter is found to be taken by degenerated cells, which were originally the cells not only of the normal connective tissue of the part, but also of the new-formed tubercle tissue. These degenerated cells, then, mixed with serum and detritus composed of softened fibres, etc., constitute what to the eye looks exactly like true pus. In other words, the focus of tubercular inflammation has simply undergone "puriform" degeneration, and the name "puruloid" is given to the material which results. The presence or absence of true pus in a cold abscess cannot be demonstrated otherwise than by the microscope. This "puriform" degeneration is really the final stage of the process known as "cheesy degeneration," which is so often set up in tubercle tissue.

It is understood that the preceding remarks apply equally well

to foci of tubercular inflammation *wherever* they occur, as in the lungs, bones, brain, kidney, etc. The following description of tubercle tissue has a similar application.

Describe tubercle tissue.

This is formed by the action of the tubercle bacillus. It is really a form of degenerated normal connective tissue, and greatly resembles regular granulation tissue. In tubercle tissue, as in normal connective tissue, there are three elements—viz. cells, fibres, and basement-substance—and it is by the peculiar *arrangement* of these elements, as observed microscopically, that tubercle tissue is recognized. This arrangement, in brief, is as follows: The *basement-substance* is hollowed out, so to speak, into minute cavities, and in these cavities are collected the *cells*, which are simply altered connective-tissue cells. This alteration is in one of two ways: in other words, *two kinds* of cells are found in these cavities—viz. *epithelioid* cells and *giant-cells*, so called, the former because they look like epithelial cells, and the latter from their resemblance to certain large cells found in the marrow of bones. The *fibres* seem to disappear from where the above-mentioned cavities are formed, but are found, perhaps in a somewhat attenuated condition, encircling these cavities and running from one to the other, thus serving merely to give support and consistency to the tissue. In a word, the basement-substance seems to be hollowed out *between* the fibres. These cavities are microscopical, and each one, when filled with its cells, is called a *tubercle granulum*. Tubercle tissue, formed in this way, may infiltrate large areas of normal tissue, and convert it into what appears to the naked eye and touch as a grayish, soft, pulpy mass. This is well seen in certain forms of tubercular synovitis.

What is a miliary tubercle?

The preceding description of tubercle tissue has been given first because it is fundamental; but there is still another way in which it may be formed, differing from the above only in the following particulars: the *tubercle granula*, already referred to, are collected so closely together that each collection forms a mass appreciable to ordinary sight and touch. This mass is very small, however, of about the size of a millet-seed, and constitutes a "miliary tubercle." In an area of tissue thus affected these tubercles are found scattered close together, and, if on a free surface, giving a sensation of general roughness to the part. Certain forms of tubercular peritonitis

show this arrangement quite markedly. Furthermore, in the centre of such a miliary tubercle are found more or less white blood-corpuscles.

Hence tubercular inflammation may occur in one of two ways, forming either—(1) “diffuse” or “infiltrated” tubercle tissue, or (2) “miliary” tubercle tissue. In both forms the *tubercle bacilli* are found either *between* the cells or *in* the giant-cells.

Finally, miliary tubercles may, in their turn, coalesce, and the resulting large *nodules* may remain as such—*i. e.* more or less circumscribed masses of tubercle tissue—or may become the seat of cheesy degeneration or suppuration, as the case may be, in the manner already described.

It is understood, of course, that infiltrated tubercle tissue may also form circumscribed areas or foci which resemble “nodules” (see above) very closely, and are susceptible to the same “degenerations.” Clinically, all circumscribed masses of tubercle tissue, no matter from which form of tubercle tissue they may have originated, are regarded as identical and receive the same treatment.

What are the symptoms of tubercular cellulitis?

As occurring in the connective-tissue planes, no especial *local* symptoms are present. We simply feel, when possible, various lumps which may or may not be painful. The general symptoms are those of septic infection, but are not present unless the inflammation is very extensive. They comprise irregular temperature, loss of flesh and strength, etc., just as they occur with tubercular pneumonia or tubercular peritonitis.

What is the treatment of tubercular cellulitis?

Removal of the foci of tubercle tissue whenever it is possible to do so. (See Treatment of “Chronic Abscess.”)

What is syphilis?

Syphilis is a disease which causes specific, productive, and chronic inflammations in various parts of the body, and is accompanied by symptoms of septic infection (constitutional symptoms of syphilis) at certain periods. These inflammations, like those of tuberculosis, affect the connective-tissue planes and the connective-tissue portions of every structure and organ in the body, and, similarly, cause a retrograde alteration of this tissue into a form of granulation tissue to which the name *syphilitic tissue* should be applied.

There is no doubt as to a special *virus* of syphilis which is prob-

ably a bacillus, though the presence of this latter has not yet been satisfactorily proved.

Describe syphilitic tissue.

It resembles infiltrated tubercle tissue in a general way, but there are no "granula." There is simply a diffuse infiltration, into the basement-substance and between the fibres, of small round and oval cells. Syphilitic tissue, thus constituted, may be spread out through an organ, as in the liver or brain, or it may be limited in area. The various syphilides and mucous patches are examples of these "limited areas." Again, syphilitic tissue may be collected into distinct rounded *nodules* appreciable to ordinary sight and touch. These nodules are called *gummata*. A special variety of syphilitic nodule must finally be mentioned. This is the *chancre*, or primary lesion of syphilis, and always appears on the skin or mucous-membrane surfaces. In chancre the *fibres* are always increased in amount, which fact accounts for its peculiar hardness. In diffuse syphilitic tissue is likewise often found a similar increase in the *fibres* of the tissue, which causes a cirrhosis of the organ affected. *Congenital* syphilis has no chancre.

(For a further consideration of syphilis see the volume of this series on *Genito-urinary and Venereal Diseases*.)

What is actinomycosis?

Actinomycosis is the name given to a disease which is characterized by the production in various parts of the connective-tissue planes and in the connective tissue of the viscera of more or less circumscribed areas of granulation tissue. The inflammation which causes this new tissue is of course productive. It is also chronic and specific.

What is the specific cause of actinomycotic inflammation?

It is a peculiar ray-fungus (actinomycetes). These fungi, probably by means of food, are taken into the system, and finally become lodged in the tissues. They are found imbedded in the masses of granulation tissue, the growth of which their presence excites. To the naked eye they appear as minute yellowish granules, and their exact configuration is to be determined by the microscope.

Describe actinomycotic tissue.

Its structure is like that of round-celled sarcoma. It may remain as such, or, as is usually the case, pus-microbes infect it

and cause suppuration. Unless such secondary infection occurs, the growth and extension of this tissue are slow.

What are the symptoms?

They are simply those of a slowly-growing tumor which is rather hard to the touch and may be painful and tender. There are no especial constitutional symptoms. Should suppuration ensue, we have simply the symptoms of acute abscess, with or without septicæmia as the case may be. A common site is in the neck near the lower jaw. Many abscesses which were originally foci of actinomycosis are doubtless opened and treated without a proper diagnosis. Search in the pus usually reveals the characteristic yellowish granules.

Thorough removal of the tissue by operative measures is the only *treatment*.

What is myxœdema?

This is a chronic, specific productive cellulitis, causing an enormous increase of connective tissue all over the body, especially of the planes, subcutaneous as well as intermuscular. The corium of the skin and the visceral interstitial tissue are similarly affected, and mucin in large quantities is everywhere present. The bones are but slightly involved. No bacillus has been found, nor does the hypertrophied tissue show anything special in its structure. Hence the term "specific" is purely arbitrary, and is used simply because it certainly is more expressive of such a peculiar disease than would be the term "non-specific."

What is the etiology of myxœdema?

The mucin referred to is supposed to cause this increase of connective tissue. One of the functions of the thyroid gland is presumably to prevent the excessive formation of mucin in the tissues. Hence in myxœdema we should expect to find the thyroid gland diseased and incapable of performing its functions. Such is found to be the fact, as in all cases of myxœdema the thyroid is destroyed by a growth of interstitial fibrous tissue, and this growth is the beginning of the entire process.

What are the symptoms of myxœdema?

A slow and general enlargement of the limbs, trunk, head, face, and neck. On palpation a general toughness and non-elasticity of the tissues is felt. The thyroid gland may be slightly enlarged at first, but the swelling soon disappears. The skin is unnaturally

smooth and waxy, at times dry and scaly. Speech and locomotion are difficult, and finally impossible. There is often impairment of intellect. There may be hemorrhages from the mucous membranes.

The *prognosis* is bad, the disease terminating fatally at the end of a few years. Women of middle age are those most often affected.

What is the treatment?

Of late years there have been reported several cases, if not of cure, yet of great improvement, by the use of subcutaneous injections of an extract of the thyroid gland of the sheep, or by the actual transplantation of the gland, or by administration of the extract through the mouth.

What is erysipelas?

This is an acute, specific, exudative inflammation of the subcutaneous cellular tissue, of the superficial lymphatics, and of the skin. Hence it is a combination of a cellulitis, lymphangitis, and dermatitis. The exudation is *serum*. No pus is present in true erysipelas, though many cases of *mixed infection* occur of suppurative cellulitis and erysipelas. The special microbe is the *streptococcus erysipelatis*. This is found in great quantities in the lymphatics, and to a less degree in the circulation. Like all other septic-infective inflammations, erysipelas may occur idiopathically—*i. e.* by bacterial invasion through a *minute* wound—or it may infect the tissues of a wound of appreciable size. The mucous-membrane surfaces may also be affected by erysipelas.

What are the symptoms of erysipelas?

Local and *general*. The general symptoms (septic infection) are practically those of a severe septicæmia. These, as a rule, begin first, and about twenty-four hours later the *local* symptoms appear. These are—a *redness* of the skin over a well-marked area, whose margin is distinct and of a somewhat irregular outline. This area is hard, especially near the margin, does not “pit” on pressure, and is swollen or not according to the normal looseness of the subcutaneous cellular tissue. From the margin radiate “fan-like projections” (Senn) of inflammation, which can be felt. Itching and burning may be present. The inflammation advances rapidly, and may involve large surfaces, even the whole body, in a few days. As it advances there is usually a tendency toward

resolution of the parts first attacked. The redness of the skin may be due to an erythema, a minute papular or vesicular eruption, or a combination of all three, according to the severity of the process. If vesicles are present, these often coalesce and form blebs. The lymphatic glands nearest the erysipelatous zone are usually enlarged.

The *course* of the disease varies from a week or ten days, usual, to a month, unusual.

Prognosis favorable, though *grave*.

What is the treatment of erysipelas?

The *general* treatment is that already given for septicæmia. In addition, the internal administration of tincture of ferric chloride is recommended by some authors. The local treatment comprises various procedures, some of which are successful in some cases and fail in others. Very often no measures are of avail, and the disease runs its course. If successful, the patient recovers in a few days. Hence the importance of *local* treatment. Frequently it is necessary to try several measures in succession, always allowing, however, at least an interval of twenty-four hours between the changes. These various ways of treatment are as follows: Wrap the part up thoroughly in gauze soaked in any one of the antiseptic solutions, and *keep* the dressing *wet*. Bichloride of mercury may be used in a solution of 1 : 500. Great care is then necessary to see that gangrene does not ensue. Or a solution, which is not really antiseptic, seems to have, in many cases, a very favorable effect. This is the so-called "lead-and-opium wash." It consists of equal parts of liq. plumbi subacetatis and tinct. opii, to which is added water according to the strength desired. Another line of treatment consists in the application of various ointments, of which ichthyol, 10 per cent., and resorcin, 60 per cent., are probably the best. The latter should be used with caution. Still another plan is to form a "fence" just in front of the margin of the erysipelatous area, the idea being to offer a direct obstruction to the growth and advancement of the streptococci. This *fence* may be formed by hypodermic injections of deliquescent carbolic acid, or by blistering with nitrate of silver, or by a series of fairly deep criss-cross scarifications made with a scalpel, or, finally, by a narrow strip of adhesive plaster which encircles the limb and is put on rather snugly. Free incisions are indicated if suppuration develops.

What is gangrenous erysipelas ?

This is that variety of erysipelas in which the inflammatory process is so severe that gangrene of the tissues, including the skin, results. It is really gangrenous cellulitis and dermatitis blending with the erysipelas. Treatment as before indicated.

What is anthrax ?

Anthrax, or malignant pustule, is an acute specific gangrenous cellulitis. It is caused by the special anthrax bacillus, which is found in herbivora, and is thus especially liable to infect those who work at hides, wool-sorting, etc. The gangrenous cellulitis of anthrax differs from non-specific gangrenous cellulitis in the following particulars: The latter is "gangrenous" from the beginning, and attacks all the tissues, *as such*, as it advances. Anthrax, on the contrary, *begins* as a serous inflammation, spreads as such, but the serum, owing to its peculiar virulency, containing as it does large quantities of the anthrax bacillus, very soon simply kills or causes regular gangrene of the skin and surrounding tissues. Hence in anthrax we are apt to have rather large, tough, sloughy masses of gangrenous tissue, as contrasted with the soft, pulaceous tissues which are the seat of non-specific gangrenous cellulitis, and which are infiltrated through and through with the sero-purulent, hemorrhagic exudation. Putrefaction may also be a marked feature in anthrax.

What are the clinical forms of anthrax ?

Malignant pustule proper and *anthrax œdema*. The latter starts from the wound or point of infection, and spreads in the manner already indicated. The *former*, after beginning in a manner presently to be described, spreads in a similar way, but to a far less extent. In fact, it may stop spontaneously, even without any especial treatment, and the patient recover.

The *prognosis* of anthrax œdema, on the contrary, is always fatal unless early and radical treatment is adopted.

The *treatment* for both forms is prompt excision or amputation.

What is the beginning of malignant pustule proper ?

At the point of infection appears a small red papule, in the centre of which is soon formed a vesicle. This is accompanied by itching and burning. At the end of twenty-four hours the papule is as large as a nickel, very red, and greatly inflamed; it is tender, painful, and firm on pressure; the vesicle has ruptured, and in its place

is a superficial gangrenous area of a blackish or brownish color. From this point on the process becomes an anthrax œdema on a limited scale, with the addition of more or less suppuration.

What are the constitutional symptoms of anthrax?

They are those of a very severe septic infection, and resemble those of septicæmia. In fact, the whole process is so markedly one of "mixed infection" that really the general symptoms may be said to be a combination of those of ordinary septicæmia, sapræmia, and the especial anthrax infection. In malignant pustule proper there are often no constitutional symptoms.

What is "internal anthrax"?

This is anthrax as it occurs in any of the viscera. Its pathology is practically the same as that of "external anthrax," already described. The lungs and intestinal canal are the organs most commonly affected. In these cases the bacilli are either inspired or swallowed.

(For a description of *leprosy* and *glanders* (equinia) see text book on *Skin Diseases* of this series.)

What is gangrene?

Gangrene is death of tissue in masses large enough to be seen. If it occurs in bone, the term "necrosis" is used. There are two forms of gangrene—dry and moist. The first presents a dry, mummified mass with blackened skin, and with little or no bad odor, owing to the slight amount of putrefaction present. The second consists of a mass of tissue which is boggy, infiltrated with serum, covered with cold bluish, more or less macerated skin, on which are blebs and bullæ. Putrefaction occurs almost immediately, and with its characteristic odor. As already stated, gangrene and putrefaction are not identical. In fact, gangrene may and does occur in some of the viscera without putrefaction. Such an area of gangrene is also called "necrosis." Moist gangrene is by far the most common variety, and presents practically the same general appearance, no matter what its causes are. *Dry gangrene* of a part results from a *gradual* stoppage of its arterial blood, the venous return remaining unimpaired. *Moist gangrene* results from a *sudden* stoppage of the arterial blood or from an obstruction to the venous return.

What are the causes of gangrene?

They may be divided into two classes—causes from without, or *external*, and causes from within, or *internal*. Of the internal

causes, *endarteritis* is the most common. This occurs chiefly in old people, whose arteries may often be felt as somewhat thickened cords, and may also be the seat of a calcareous degeneration. This endarteritis causes a gradual diminution of the lumen of the artery going to any given region, with eventual obliteration. Dry gangrene is the result. Clinically this is known as *senile gangrene*. It may also occur as the moist form. Any variety of *embolus* may cause gangrene, usually "moist," as may also *pressure on veins* from a tumor, a constricting band, a *large thrombus*, or a *chronic phlebitis*. *Cellulitis* causes gangrene, always more or less "moist," in one of two ways—either as a "gangrenous cellulitis" or by its exudate. (See Anthrax.) The former is often called "inflammatory gangrene." Finally, certain constitutional diseases, such as *diabetes* and those manifested by disturbances of the *trophic nerves*, complete, in a general way, the *internal* causes of gangrene.

The *external* causes comprise all forms of traumatism. This is "traumatic" gangrene.

What is the "line of demarcation"?

In gangrene other than "inflammatory," especially senile, there may be *slow advance* of the gangrene, corresponding to a similar progression of the causative arterial or venous disturbance. If this cause does not advance, then the resulting gangrene is limited and stationary. When this stoppage takes place, there is formed, immediately in front of the gangrene, a zone of ulceration, which in its turn is in immediate contact with an area of inflammation, while still farther in advance is uninvaded healthy tissue. This "zone" of ulceration and inflammation is the "line of demarcation." It is really the process of repair taking place in such an active way that it practically constitutes inflammation.

What is the treatment of gangrene?

As it is in all forms of gangrene, amputation *through healthy tissue* is the *treatment* for senile gangrene as well. But in the latter it is best to wait for the line of demarcation to form. In traumatic gangrene immediate amputation is indicated, or as soon as the patient has sufficiently rallied from shock. The treatment of inflammatory gangrene has been given under "Gangrenous Cellulitis." Diabetic gangrene presents the peculiarity of slow and steady advance, except an unusually high amputation be performed. Thus if the great toe is the site of the beginning of a true diabetic gan-

grene, amputation through the *lower third* of the thigh is indicated. Otherwise the prognosis is fatal.

It should be remembered, of course, that any form of gangrene other than inflammatory may be infected by "inflammatory gangrene" or gangrenous cellulitis. This is really what happens in cases of "rapidly-spreading" senile, embolic, neuropathic, or traumatic gangrene.

What are the malformations of the connective-tissue planes?

The various *cicatricial contractions* resulting from extensive loss of substance, *Dupuytren's contraction*, and *webbed fingers*. The first mentioned cannot be treated in detail. Their treatment should be by plastic operations.

Describe Dupuytren's contraction.

This is a contraction of the *palmar fascia*, producing more or less flexion, usually, of the little and ring fingers, especially at the metacarpo-phalangeal and proximal interphalangeal articulations. The tendons are not involved. The actual cause of this fascial contraction is a thickening and shrinking of the fascia, which may be due to traumatism, but is much more frequently idiopathic (Fig. 6).

FIG. 6.



Dupuytren's contraction. From a dissection by Mr. Partridge in King's College Museum.

Treatment is operative. A V-shaped flap, base downward, is reflected, and the constricting fascia is dissected away. Closure of wound if practicable, its dressing, and application of a straight splint follow. Retention of the splint should be maintained for a

considerable time after healing. Or the bands may be divided subcutaneously or by a number of transverse incisions.

What are "webbed fingers"?

Syndactylism, or webbed fingers, is the union of two or more fingers to a varying extent, and is of congenital origin. The *web* may be simply skin or skin enclosing more or less connective tissue, and passes between the fingers both on their palmar and dorsal aspects.

Treatment.—Raise a rectangular *dorsal* flap, which includes half the thickness of the web, by a longitudinal incision, equal in length to the web, along the middle of one finger. Make a similar *palmar* flap by an incision along the middle of the *other* finger. Then wrap each flap around the raw surface of the finger to which it is attached, and suture. Each flap must be dissected up to the middle line of the finger around whose raw surface it is to be applied.

What are the tumors of the connective-tissue planes?

These belong to the connective-tissue class of tumors, and are the same as may be developed from the connective-tissue elements of any organ.

(For a further explanation see section on Tumors.)

TUMORS AND CYSTS.

What is a tumor?

A tumor is a more or less circumscribed mass of tissue the *cells* of whose structure are of the same *kind* as those of the tissue in which it is found or from which it is derived.

How are tumors divided?

Inasmuch, then, as tumors are derived from the tissues of the body, and their cellular structure is the same as that of their parent tissue, so to speak, it follows that there must be, from a structural point of view, as many kinds of tumor as there are tissues. From histology and embryology we know that there are but two main tissues in the body—viz. *epithelial tissue* and *connective tissue*. Hence there are two main kinds or classes of tumors—epithelial-tissue tumors and connective-tissue tumors. A tumor of the first class never develops from connective tissue, nor does

a tumor of the connective-tissue class ever develop from epithelial tissue.

What is meant by epithelial tissue?

This is the tissue, made up of layers of epithelial cells, which forms the surface of the skin and mucous membranes, and also lines the ducts of their corresponding glands. It also means the purely "nervous" elements of the brain, the spinal cord, and the nerves. Hence we have three varieties of epithelial tissue—surface, glandular, and nervous.

What is meant by connective tissue?

This embraces all the rest of the body—viz. the corium of the skin and mucous membranes. the vessels, the bones and cartilages, the interstitial structure of the nervous system and of all "glands" and organs, and finally the muscles (these also being derived from the mesoblast or middle layer of the blastoderm).

Describe the epithelial-tissue tumors.

They correspond to the three kinds of epithelial tissue. Those made up of "nervous" epithelial tissue are called *neuromata*, whose structure is simply convoluted true nerve-fibres. Their occurrence, except on the ends of nerves after resection or amputation, is exceedingly rare. Each of the two remaining varieties—i. e. "surface" and "glandular"—are further subdivided into "typical" and "atypical" tumors.

Typical Surface Epithelial-tissue Tumors.—These occur on the surface of the skin and mucous membranes. They are called "typical" because their cells not only are of the *same kind* as those of the corresponding "surfaces," but also are *arranged* in the same way. Part of the structure of each of these tumors is connective tissue, which is derived from the corium. Strictly speaking, then, these tumors are of a mixed type. In fact, by some they are put in the connective-tissue class. On the *skin* they are known as *papillomata* and *warts*; on the *mucous membrane*, as *villous growths* and as certain forms of *polypi*.

Atypical Surface Epithelial-tissue Tumors.—These have no connective-tissue elements. They are purely of the class to which they belong. They are called *epitheliomata*. On the *skin* they receive the term "squamous;" on the *mucous membrane* the descriptive word "columnar" is used. They are "atypical" because their

epithelial cells, although, individually, identical with normal squamous or columnar epithelium, as the case may be, have a *different mutual arrangement* from that which obtains in the regular epithelium from which they are derived.

Typical Glandular Epithelial-tissue Tumors :

Describe these tumors.

They occur in the regular secreting glands. Their structure is practically that of the gland from which they are developed, except that there is no *excretory* duct. Their epithelial cells have a *normal arrangement* ; hence these tumors are called "typical." They are really circumscribed masses of glandular tissue. This of course means that, like that of regular secreting glands, part of their structure is connective tissue. For this reason they are regarded by some as belonging to the class of connective-tissue tumors. They are called *adenomata*, irrespective of the fact whether the glands from which they develop open on a skin or mucous-membrane surface.

Atypical Glandular Epithelial-tissue Tumors :

Describe these tumors.

Like the preceding, they occur in secreting glands, and similarly their structure is mixed—*i. e.* is made up of both epithelial and connective tissue. But the former takes predominance, and these tumors are never regarded as of the connective-tissue class. The epithelial cells are arranged in irregular masses, and each mass is separated from another by bands of connective tissue, called the *stroma*. This arrangement of the cells is of course unique, and is utterly unlike that of the cells of normal glandular epithelium. Therefore these tumors are "atypical." They are called *carcinomata*, whether they originate in glands opening on the skin or in those which open on the mucous membrane. A carcinoma, furthermore, is called *scirrhus*, or hard, if the stroma is in excess of the cells ; while if the *latter* are in excess, the carcinoma is called *encephaloid*, or soft.

Describe the connective-tissue tumors.

Just as in the case of the surface and glandular epithelial-tissue tumors, those of the connective-tissue class are subdivided into two groups—*viz.* *typical* and *atypical*.

Typical Connective-tissue Tumors :

Describe these tumors.

Each tumor of this group in its structure is like either one of the *simple* or one of the *complex* varieties of connective tissue. The following classification will explain this:

TYPICAL CONNECTIVE-TISSUE TUMORS.

Tumors.	Variety of Connective Tissue.	
Fibromata	Fibrous tissue.	} Simple.
Lipomata	Fatty “	
Chondromata	Cartilage.	
Osteomata	Bone.	
Myxomata	Mucous tissue.	} Complex.
Myomata	Muscular tissue.	
Angeliomata	Blood-vessels.	
Lymphangiomata	Lymphatics.	
Lymphomata	Lymphatic glands.	

*Atypical Connective-tissue Tumors:***What are these tumors?**

They are called “atypical,” because their structure does not resemble any one of the varieties of connective tissue as found in the *adult*. It is in the *embryo* that this connective tissue occurs which the structure of these tumors resembles, and the tumors are called *sarcomata*. They may be spindle-celled, giant-celled, round-celled, etc., according to the shape of the *cells*.

What are “malignant” tumors?

These are the *epitheliomata*, the *carcinomata* and the *sarcomata*. They are called “malignant,” from the bad effect, if let alone, their course has upon the system. Their clinical characteristics are—rapid growth with infiltration of the surrounding tissues; a tendency to adhere both to the skin and the subjacent tissues; pain; often recurrence after removal; metastasis; involvement of lymphatic glands; general cachexia.

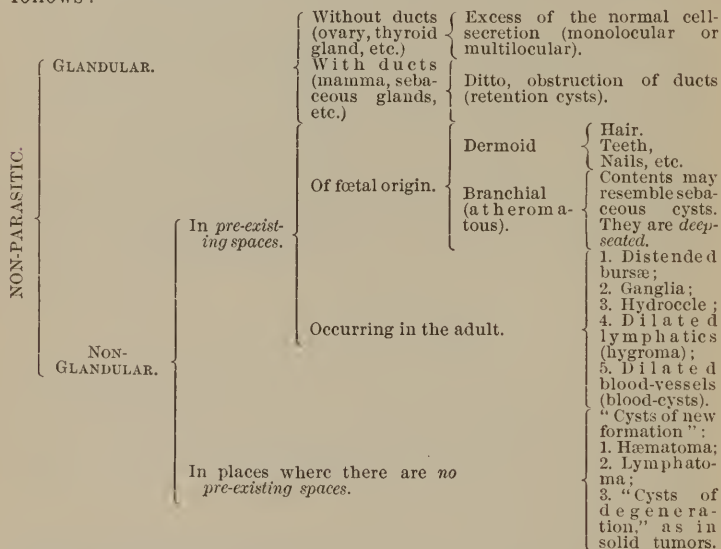
What are “benign” tumors?

These comprise *all* the other tumors. Their effects are simply local. The system at large does not suffer. Their clinical characteristics may be said to be just the opposite of those of malignant tumors.

Certain tumors may be a combination of the malignant and benign types—thus, fibro-sarcoma, myxosarcoma, etc.

What are cysts?

They are hollow tumors filled with fluid or semisolid contents. They are classified according to their mode of development as follows:



PARASITIC.—Hydatids, cysticercus, etc.

FRACTURES.

What is a fracture?

It means, literally, a *break*. As the term is exclusively used in connection with bones, it thus signifies a break of a bone or a *broken bone*.

What is the cause of fractures?

Violence in its various forms. This may be exerted from *without*, as in blows, falls, etc.; or from *within*, as by muscular action. The former class is further subdivided into *direct* and *indirect* violence.

Examples: Fractures by direct violence are those occurring immediately at the site of the receipt of the injury. Those by indirect violence occur at some point remote from this site. The most common fracture due to muscular action is that of the patella, caused by contraction of the quadriceps extensor.

What are the varieties of fracture?

All fractures are either *simple* or *compound*. A *simple* fracture is one occurring without a *wound*. A *compound* fracture always has an *accompanying wound*—*i. e.* one that leads to the site of the fracture.

Further varieties of fractures are as follows: A fracture, simple or compound, may be complete or incomplete; multiple, comminuted, or impacted; V-shaped, T-shaped, longitudinal, transverse, or oblique; a fissure, depression, or a splinter; intra-articular, etc. A variety of transverse fracture is *separation of the epiphysis* in bones whose ossification is incomplete. A *multiple* fracture is one in which a bone is broken in two or more places, the fragments

FIG. 7.



Diagram of Comminuted Fracture.

FIG. 8.



Impacted Fracture of Neck of Femur (Mutter Museum).

being of considerable size. A *comminuted* fracture is one in which there are numerous small fragments. A "green-stick" fracture is simply an incomplete fracture of a long bone (Figs. 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18).

FIG. 9.



Longitudinal Fracture (Stimson).

FIG. 10.



Incomplete Fracture of Femur (Gurli).

FIG. 11.



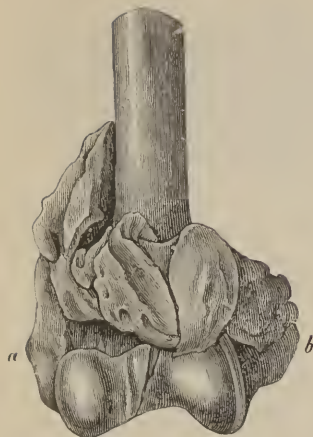
Separation of the lower epiphysis of the femur (Bryant).

FIG. 12.



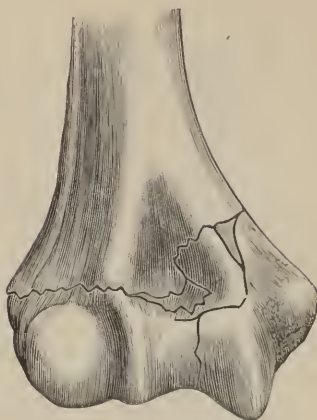
Intra-articular fracture of the head of the tibia, with impaction and separation of the upper fragments.

FIG. 13.



Intra-articular fracture of the lower end of the humerus, with exuberant callus, especially in front.

FIG. 14.



Interecondyloid fracture of the humerus.

FIG. 15.



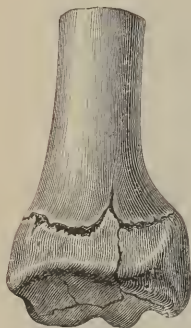
Comminuted fracture of the femur, with splitting of the condyles.

FIG. 16.



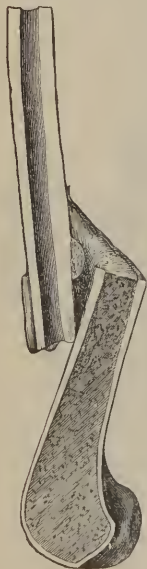
Comminuted fracture of the neck of the femur.

FIG. 17.



Comminuted fracture of the lower end of the radius. Palmar aspect.

FIG. 19.

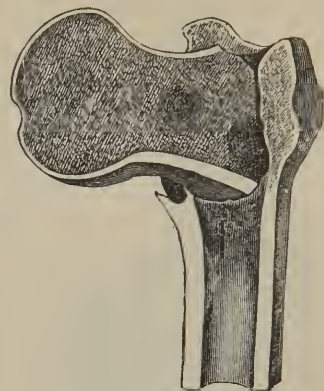


Transverse fracture of the femur (Gurlt).

FIG. 20.



FIG. 18.



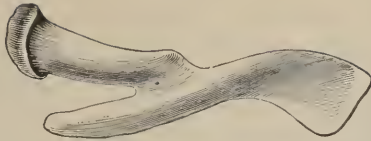
Impacted fracture of the neck of the femur without splintering. Vertical section.

FIG. 21.



Angular displacement.

FIG. 22.



Fracture of the clavicle. Union with extreme displacement.

What are the symptoms of a fracture?

Crepitus; false point of motion; displacement with resulting deformity; swelling; pain; loss of function.

Crepitus is the grating obtained by rubbing two fragments of a fracture together. It may be heard or felt.

FIG. 24.



Fracture of both bones of the leg, with over-riding.

FIG. 23.



Rotary displacement after fracture of the neck of the femur.

FIG. 25.



Fracture of the lower end of the radius. Angular displacement of the lower fragment backward with impaction (R. W. Smith).

FIG. 26.



Fracture of the fibula. Longitudinal separation.

False point of motion is the abnormal point of mobility between two fragments at the site of the fracture.

Displacement is the position the fragments may assume with respect to each other. It may be one or more of the following varieties: *Transverse*, in which the fragments are *laterally* or *antero-posteriorly* displaced; *angular*, in which the fragments assume an angle; *rotary*, in which one fragment is twisted on its long axis; *overriding*, in which the fragments override each other; *direct longitudinal separation*, in which the fragments are separated in the direction of the long axis of the bone; *impaction*, in which one fragment is forced into the other. This last variety usually shows neither crepitus nor false point of motion. These different kinds of *displacement* have special reference to the *long bones* (Figs. 19, 20, 21, 22, 23, 24, 25 and 26).

What is the treatment of fractures ?

Reduction and immobilization. By *reduction* is meant the replacing of the fragments in their proper position—*i. e.* to restore as nearly as possible the condition (as to *position*) of the previously unbroken bone. If the fragments so placed are properly held, union between them will occur. This holding together of the fragments is called *immobilization*. Various materials are used for this purpose, the most common being wooden splints and plaster of Paris. Besides these, numerous kinds of apparatus and appliances are employed for special fractures, such as Buck's extension, Volkmann's tin-splint, etc. Whatever material or apparatus is used, the part should first be thoroughly protected with plenty of ordinary—*i. e.* non-absorbent-cotton. From six to eight weeks is usually required for bony union; hence splints, etc. should not be removed before that time, except for inspection, after which they should be reapplied.

The treatment of *compound fractures* differs in no respect from that of simple fractures, except that the *wound* must always receive the most careful attention, which comprises the following points: Shave and wash the surrounding skin with soap and hot water, disregarding the possible entrance of the latter into the wound. Then similarly use a mixture of equal parts of ether and alcohol, and finally a solution of 1 : 2000 bichloride of mercury. Now insert the finger in the wound to obtain information as to the existence of pockets, loose fragments of bone, etc. All pockets should be slit up, blood-clots turned out, all hemorrhage stopped, and loose pieces of bone removed. Then, as a general rule, the cavity should be packed with iodoform gauze, rather than an attempt made to secure primary union by suturing. Over this gauze is placed a regular antiseptic dressing, and finally the immobilizing apparatus. This is all done, of course, under ether, which should also be employed for the treatment of most of the simple fractures. Wiring the fragments may be necessary.

Special fractures will now be taken up, and of these only the more important will be considered. When no special symptoms are mentioned, those already given for fractures in general will apply. When they are given, it is understood, of course, that those for fractures in general are also present.

FRACTURES OF THE LONG BONES.

What are the symptoms of fracture of the neck of the femur?

We will assume the fracture to be *complete* and non-impacted. In old people, or in those whose bones are weakened from disease or disuse, the site is usually near the *head* of the bone. In strong adults the break is, as a rule, near the great trochanter. Hence, from the position of the capsule of the joint, in the former case the fracture is intra-capsular, and in the latter partly intra- and partly extra-capsular. The *special symptoms* are: outward rotation of the entire limb, shortening, and a *movement of the great trochanter on passive rotation of the femur*. To estimate "shortening" of the lower extremity, use either Nélaton's (*a*) or Bryant's (*b*) line: (*a*) Pass a tape-measure from the anterior superior spinous process of the ilium to the tuberosity of the ischium on the affected side, and observe the position of the great trochanter to this line. Do the same thing on the sound side, and then compare the results. Whichever trochanter is higher indicates shortening of the corresponding limb. (*b*) Make a similar comparison between the position of each great trochanter with reference to a line dropped perpendicularly to the table from the corresponding anterior superior spinous process of the ilium.

In *impacted* fracture of the neck of the femur all the usual symptoms may be absent.

A complete non-impacted fracture of the *shaft* of the femur immediately below the great trochanter resembles fracture of the neck, and often can only be distinguished from it by the fact that the trochanter *does not move* on passive rotation.

What is the treatment of fracture of the femur?

Of the *neck*, Buck's extension apparatus. Of the *shaft*, the same, and in addition coaptation splints should be applied around the thigh. In either, plaster of Paris may also be used, especially in children. In this case the plaster bandages are put on in the form of a *spica*—*i. e.* passing from the upper part of the thigh around the body as a figure of 8. Or some form of orthopædic apparatus may be used, and the patient at once allowed to move about (Ridlon).

What is the treatment of fracture of the leg?

It is the same whether the tibia or fibula alone or both are broken. Should the former be fractured close to the knee-joint,

immobilization of this joint would be necessary. In other cases proceed as follows: After reduction of the fragments wrap the leg thickly with ordinary cotton from just above the toes to the knee. Then apply over all the cotton a gauze bandage snugly enough to keep the cotton in place. The cotton should be especially thick over the malleoli. Along each side of the leg now place a wooden splint, at least half an inch in thickness, whose width should exceed the antero-posterior diameter of the leg, and which in length should extend from just below the knee-joint to an inch or so below the sole of the foot. Hold these splints in place by two or three narrow strips of adhesive plaster, and then put on a stout muslin bandage from the toes to the knee. After a week, or even less, this apparatus may be removed, a plaster-of-Paris splint applied, and the patient allowed up on crutches. Should there be little or no swelling, the plaster of Paris may be used from the beginning.

What is Pott's fracture?

It is the name usually given to any fracture of the lower ends of the tibia and fibula accompanied by marked abduction and eversion (rarely adduction and inversion) of the foot. More accurately, it may be defined as follows: *Fibula* fractured three inches above the malleolus; *tibia* fractured in two places—viz. through the internal malleolus and through a line just internal to its lower articular surface for the fibula (Fig. 27). In addition there is often rupture of the internal lateral ligament of the ankle-joint and of the inferior tibio-fibular articulation. The foot is always displaced in one of the ways mentioned above.

FIG. 27.



Diagram showing frequent fracture-lines from forcible eversion and abduction of foot. (Stimson).

What may be said as to fractures of the humerus?

If situated high up, through the surgical or anatomical neck, the upper fragment is usually to be felt as a distinct mass in the axilla. The treatment, after reduction, of all simple fractures of the humerus above the lower third is by the plaster-of-Paris spica,

FIG. 28.

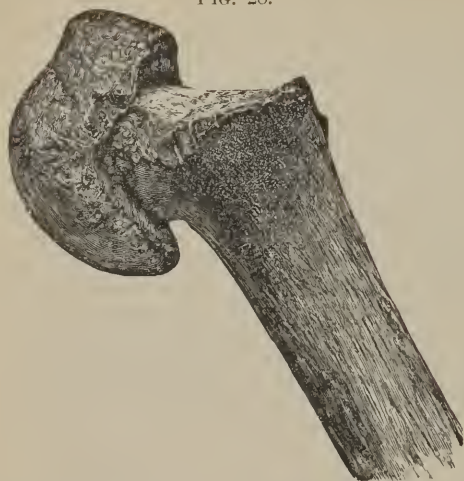


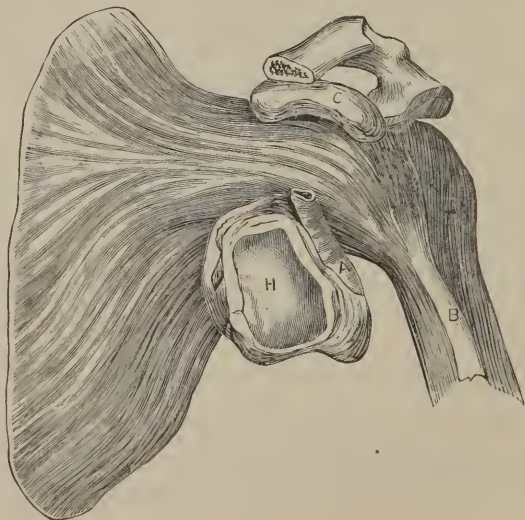
FIG. 29.



Separation of the upper epiphysis of the humerus; displacement forward of the lower fragment (Moore).

Fracture of the surgical neck of the humerus.

FIG. 30.



Fracture of the anatomical neck of the humerus, and dislocation of the head. *H*, the head; *C*, the coracoid process; *A*, axillary artery; *B*, tendon of the biceps.

FIG. 31.



Supra-condyloid fracture of the humerus (Hutchinson).

FIG. 32.



Supra-condyloid fracture of the humerus.

starting from *just above* the elbow-joint and ending by completely covering in the shoulder-joint. The elbow should be flexed, and held so by means of a sling placed under the hand. Or wooden splints, encircling the arm, over ordinary cotton, are efficacious if

FIG. 33.

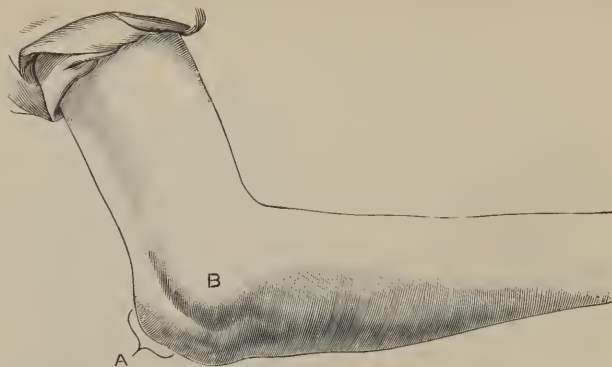


Fracture of the internal epicondyle of the humerus (epitrochlea) (Gurlt).

FIG. 34.



Fracture of the external epicondyle of the humerus (Gurlt).



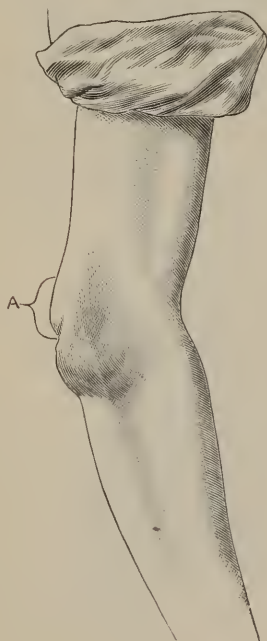
Ununited fracture of the olecranon. *A*, the upper fragment. *B*, the external condyle (Stimson).

FIG. 36.

FIG. 37.



Fracture of coronoid process of the right ulna. United with exuberant callus on the anterior surface, line of fracture still visible on the articular surface. *a*, a small fragment broken from the articular border of the olecranon and reunited (Gurlt).



The same; the arm extended.

FIG. 38.



Fracture of the coronoid process and the head of the radius (Bryant).

FIG. 39.



Fracture of the forearm, angular displacement, and union between the bones.

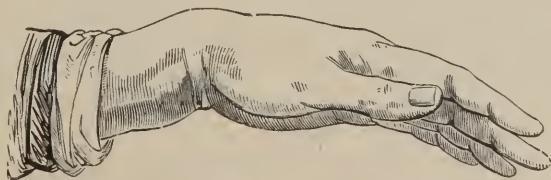
FIG. 40.



Fracture of the forearm, with formation of a lateral joint.

the gypsum be not obtainable. Fractures of the humerus situated lower down (see Dislocation of the Elbow) should, as a rule, be treated by fixation of the elbow either in the flexed or extended position.

FIG. 41.



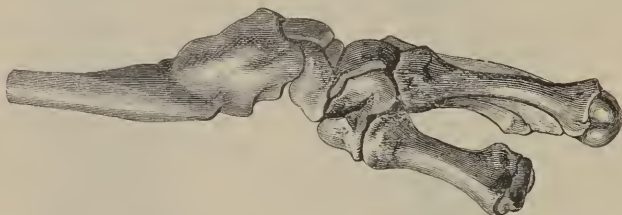
Deformity in Colles's fracture.

The latter position is also advisable in fracture of the *olecranon process* of the ulna (Figs. 28, 29, 30, 31, 32, 33 and 34).

Describe fractures of the forearm.

Either the radius or the ulna may be broken, or, as is most common, both bones are affected. If of the shaft, the treatment is practically that of *Colles' fracture*, which last is one of the most common of the fractures of the forearm. In this fracture the bone involved is the radius, and the line of fracture passes about three-quarters of an inch above the wrist-joint. The lower fragment, together with the hand, is displaced *backward* and *upward*. The extreme lower end of the ulna is sometimes, though rarely, broken also (Figs. 35, 36, 37, 38, 39, 40, 41 and 42).

FIG. 42.



Colles's fracture. Union with persistence of displacement (Smith).

Treatment.—Reduce by steady traction, preceded, if necessary, by hyperextension. Then immobilize as follows: Adduct the hand to correct the usual over-abduction of the lower fragment; apply ordinary cotton from just above the metacarpo-phalangeal joints to the elbow, the forearm being flexed and semipronated. An anterior and a posterior wooden splint should now be put on in a manner precisely similar to that given in the Treatment of Fracture of the Leg. These splints should be at least half an inch thick, and should each be a little wider than the forearm. Superiorly, they should extend *to* the elbow; inferiorly *to* the metacarpo-phalangeal joints. Some authorities state that the wrist-joint need not be immobilized. Inspection should be made every week or ten days.

Describe fractures of the clavicle.

Those of the *outer* and *middle* third are most common.

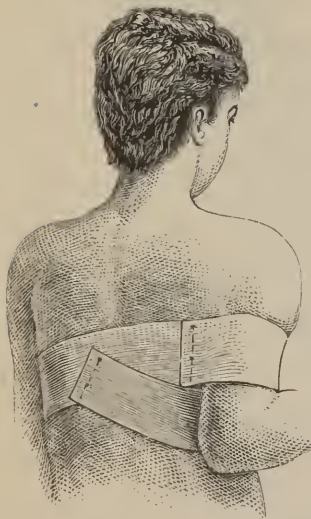
The *middle third*: the whole shoulder drops, and the usual dis-

FIG. 43.



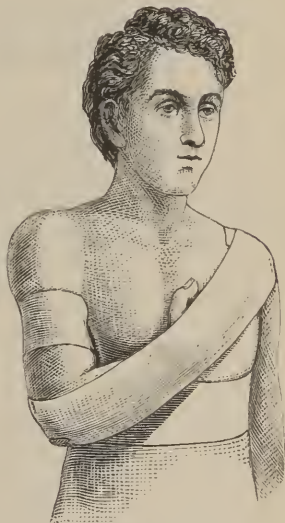
Velpeau's dressing for fracture of the clavicle.

FIG. 44.



Sayre's adhesive plaster dressing for fracture of the clavicle. First piece.

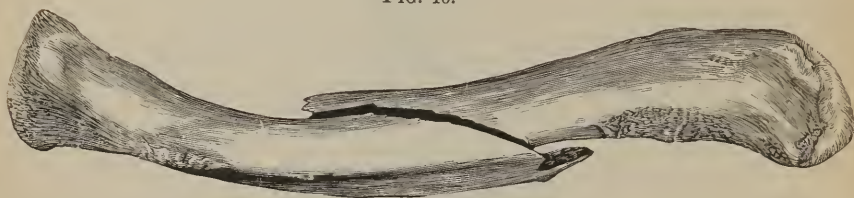
FIG. 45.



The same. Second piece.

placements are of the outer fragment, downward, forward, and inward. Hence in reduction the shoulder must be *raised* by sup-

FIG. 46.



Oblique fracture of the clavicle.

port under the elbow ; it must be drawn *backward* and forced *outward*. This last is effected by putting a pad in the axilla and by

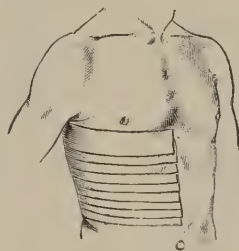
FIG. 47.



Fracture of the clavicle, inner third (Gurlt).

pressing the lower end of the humerus close to the body. Cotton and a Velpeau bandage are then applied. Or two strips of adhe-

FIG. 48.



Adhesive plaster strips applied for fracture of the ribs.

sive plaster may be employed after the manner of Sayre (Figs. 43, 44 and 45).

The *outer third*: there is *no falling of the shoulder*, due to the support of the coraco-clavicular ligaments (Figs. 46 and 47).

Describe fractures of the ribs.

For diagnosis carefully palpate each rib along its course. Immobilize by a broad piece of adhesive plaster placed right around the chest or as indicated in Fig. 48. To obtain the most complete immobility possible, apply the plaster at the end of expiration. This is not essential, however, and is often very oppressive to the patient.

Laceration of the pleura or lungs must always be considered as possible complications.

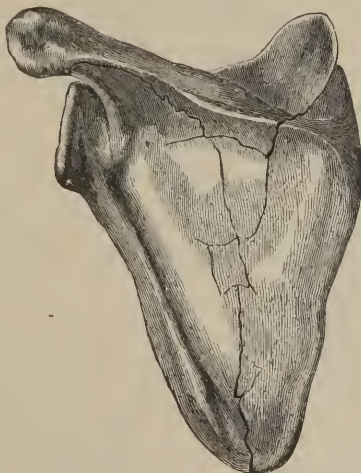
FRACTURES OF THE FLAT BONES.

Describe fractures of the os innominatum.

The more common are those of the *ilium*.

There is no especial *treatment* except to keep the patient flat on

FIG. 49.



Multiple (longitudinal) fracture of the scapula.

his back and his legs as quiet as possible in the extended position. Very often a strip of adhesive plaster passed snugly around the body below the crests of the ilia is of service.

Fractures of the *pubes* or *ischium* are similarly treated. If, as is more apt to occur in these cases, there is marked displacement of the fragments, and one which tends to recur after replacement,

FIG. 50.



Fracture of the posterior angle of the scapula (Hamilton).

wiring must be resorted to. Always examine the bladder and urethra in all fractures of the pelvis.

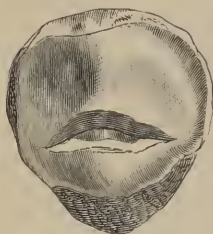
Describe fractures of the scapula.

Any one of the anatomical subdivisions of this bone may be fractured (Figs. 49 and 50).

Diagnosis is made by careful palpation.

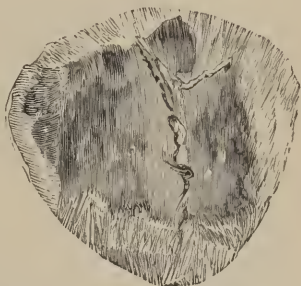
Treatment consists in immobilizing the scapula and the humerus. It may be impossible to replace the fragment, especially if it be the inferior angle.

FIG. 51.



Incomplete fracture of the patella.
Articular surface.

FIG. 52.



Vertical fracture of the patella
(Holmes).

What may be said as to fractures of the patella?

If simple and transverse (the most common), two lines of *treatment* are recommended: (1) Approximate the fragments by pressure, the leg of course being fully extended, and retain them in

FIG. 53.



Oblique fracture of the patella.

FIG. 54.

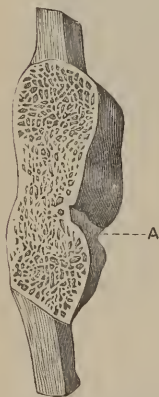


Comminuted fracture of the patella. Bony union. Exuberant callosity at several points (Gurlt).

place by strips of adhesive plaster or other apparatus. The knee is then to be kept in extension by plaster-of-Paris or other appliance for two or three months. This is succeeded by massage and passive motion. (2) Direct wiring of the fragments. This may be done through either a transverse or a longitudinal incision. The joint is always opened. If asepsis has been strictly carried out, the entire wound may be closed without drainage. Immobilization for six weeks should follow.

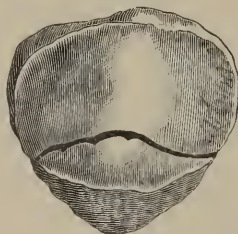
Wiring is *always* indicated in compound fractures, and in multiple fractures whether simple or compound (Figs. 51, 52, 53, 54, 55, 56, 57 and 58).

FIG. 55.



Bony union after fracture of the patella. Specimen 201 of the Musée Dupuytren.

FIG. 56.



Fracture of the patella. Articular surface.

FIG. 57.



Fracture of the patella. Anterior surface (bony union).

FIG. 58.



Multiple fracture of the patella (Bryant).

Describe fractures of the sternum.

The most common one is in the upper part of the *body* or at the junction of the latter with the manubrium. Direct pressure on the

overriding fragment usually suffices for reduction. Adhesive plaster is then used, as in fractures of the ribs.

FRACTURES OF THE BONES OF THE HAND AND FOOT.

Describe fractures of the metacarpus or metatarsus and phalanges.

Treatment and *diagnosis* are essentially the same as that of the larger "long" bones. Immobilization of the ankle- or wrist-joint may be advisable except in fractures of the phalanges.

Describe fractures of the carpus and tarsus.

The *diagnosis* is often difficult, and to be accurate requires a good knowledge of the anatomy of the parts.

Treatment consists in immobilizing the corresponding joints.

FRACTURES OF THE SKULL.

Describe fractures of the skull.

The same considerations as to classification apply to these as to all other fractures. On account of the brain, however, the element of *depression* is of the utmost importance, while in fractures of other bones its presence or absence is of secondary moment. In all cases of suspected simple fracture of the skull an exploratory incision should be made. A hæmatoma of the scalp of some standing, whose centre is soft, but whose edges are becoming hard through coagulation and commencing organization, very often feels like a depressed simple fracture.

Fractures of the skull are said to be complete or incomplete according to whether both tables or only one is broken. Fracture of the inner table alone is of course only made out by trephining or inferred from the symptoms of *cerebral compression*. The presence or absence of these *symptoms* have an important bearing on treatment.

What is the treatment of fractures of the skull?

This has reference to the operative treatment or trephining, and is answered as follows:

1.	Simple fracture,	without depression,	without symptoms—	No.
2.	"	"	"	(internal table?)
			with symptoms—	Yes.
3.	"	with	"	without " —Yes.
4.	"	"	"	with " —Yes.
5.	Compound	without	"	without " —No.
6.	"	"	"	with " —Yes.
7.	"	with	"	without " —Yes.
8.	"	"	"	with " —Yes.

To sum up: all cases of fracture of the skull should be trephined except Cases 1 and 5. They, however, should be carefully watched, as the internal table may be broken.

What is meant by fracture of the base of the skull?

This simply means a fracture of any portion of the *base* of the skull. This region being practically inaccessible for purposes of diagnosis or operation, all fractures in this situation are grouped together, though, of course, strictly speaking, they should be classified in the same manner as the preceding varieties, which, clinically, are fractures of the *vault* of the skull.

What are the symptoms of fracture of the base of the skull?

These are *local* and *general*. The latter are those of cerebral compression (which see). Owing to the presence of large vessels at the base of the brain, one or more of these are sure to be torn. The resulting hemorrhage causes cerebral compression.

The *local* symptoms are also those of hemorrhage, and vary according to the situation of the fracture. Thus:

Fracture of—	Local Symptoms.
Anterior fossa.	{ Subconjunctival hemorrhage; Hemorrhage from the nose; " " vault of the pharynx;
Middle fossa.	{ Hemorrhage from external auditory meatus; Flow of cerebro-spinal fluid from "
Posterior fossa.	{ Slow formation of hæmatema below and in front of mastoid process.

The *local* treatment of these fractures consists in careful cleansing of the cavities affected, nose, ear, etc. The *general* treatment

is that of cerebral compression. Patients so affected may lie unconscious for weeks and yet recover.

What is fracture of the skull by contrecoup?

This means a fracture situated on the side opposite to that on which the blow was received.

FRACTURES OF THE BONES OF THE FACE.

Describe these fractures.

The only ones which merit special mention are those of the nasal bones and inferior maxilla.

The Nasal Bones.—The diagnosis is easily made by palpation. Replacement should be made at once by pressure on a grooved director or other instrument passed up the nostril. As a rule, the fragments remain in place. Strips of adhesive plaster passed across the nose are of very doubtful utility.

The Inferior Maxilla.—Replacement by direct pressure. The four-tailed bandage is the usual treatment. Some form of dental splint, however, is preferable. The usual site is anterior to the junction of the ramus with the body of the jaw. Displacement is indicated by the change of level of the teeth.

FRACTURES OF THE VERTEBRÆ.

What may be said as to these fractures?

They are comparatively rare. The vertebræ usually affected are the lower cervical or upper dorsal and the lower dorsal or upper lumbar. The bodies or arches may be broken. Fractures of the former give rise to symptoms of compression of the spinal cord. The latter have the usual local symptoms of fracture with or without compression of the cord (Fig. 59).

Prognosis very unfavorable if the cord is compressed or lacerated.

Laminectomy may be performed on fractures of the arches with compression. Good results have been obtained. Otherwise there is no special local treatment.

Explain the terms "delayed union" and "ununited fracture."

These terms both mean a fracture whose fragments have failed to unite after both proper treatment and the lapse of the regular time required. At first this condition is called *delayed union*, but

if failure to unite persists after treatment for some weeks, the condition becomes *united fracture*.

What is the pathology?

The "bony-cicatricial tissue" referred to under Repair of Fractures has failed to ossify, and exists only as *fibrous tissue*, which may enclose bony nodules, and whose length varies according to

FIG. 59.



Displacement of the vertebræ causing compression of the spinal cord.

the amount of separation of the fragments. Sometimes this fibrous union is only *around the circumference*, forming a kind of capsular ligament. The ends of the fragments in such cases have become smooth and hard, and move freely on each other. This variety of ununited fracture is called *pseudarthrosis* or false joint.

What is the treatment for these varieties of fibrous union?

Delayed union: moderate use of the part. If in the lower extremity, locomotion with some kind of orthopædic apparatus is indicated.

Ununited fracture: forcible bending of the limb at the site of the fracture, or drilling holes through the fibrous union and the con-

tiguous portions of the bone; incision with removal of the fibrous tissue, and sawing off a layer of bone from each fragment with wiring or not; in all cases to be followed by careful immobilization.

Pseudarthrosis: regular excision of the false joint and immobilization.

What are some of the causes of fibrous union?

Tubercular or syphilitic inflammation; interposition of too much periosteum or fascia, etc. between the fragments; excessive comminution; too great loss of substance in compound fractures; improper treatment, such as faulty immobilization, or too early use of the part.

DISLOCATIONS.

What is a dislocation?

A dislocation or luxation is a complete separation from each other of those portions of bones which go to make up the constitution of a joint. An incomplete dislocation is often called a subluxation. A compound dislocation is one which is complicated by the presence of a wound. A *sprain* is a laceration, of greater or less extent, of the ligaments of a joint.

What are the causes of dislocations?

They are *the same* as those of fractures (which see). Muscular action rarely produces dislocation in healthy people, except in professional contortionists. Joints which are diseased are those which are usually dislocated by muscular action, such dislocations being called *pathological*. *Congenital* dislocations are those caused by muscular action or lack of development in utero.

What are the symptoms of a dislocation?

Displacement: the ends of the bones occupy an abnormal position with respect to each other.

Shortening: to be estimated by measurement from some point above the joint to any point on the side of the lower bone *opposite* to the dislocation. Thus, if the dislocation of the end of the bone is *inward*, the point should be taken on the *outer* side, and *vice versa*.

Immobility: As a rule, a joint which has been dislocated is much restricted in motion. Should all the ligaments be torn—a

rare and severe form—there would be abnormal mobility. In addition to these symptoms there are also pain, swelling, and loss of function.

What is the treatment of dislocations?

Restoration of the ends of the bones to their normal position. As a rule, ether should be given. The two methods resorted to are *traction* and *manipulation*. The latter should be used first. If it fails, then traction may be tried. The general rules of procedure in manipulation are—

(a) *Increase the deformity*: this loosens up the head of the bone; then

(b) *Reverse quickly* the motions by which the deformity was increased: this will effect the desired reduction.

FIG. 60.



High Dorsal Dislocation.

The after-treatment is rest until the rent in the ligaments is healed. This usually requires from four to six weeks. When necessary, pads and bandages should be used to retain the bones

in place. Manipulation of course is available only for the common *typical* dislocations—*i. e.* those in which there is only a rent or tear of the ligaments through which the head of the bone has slipped.

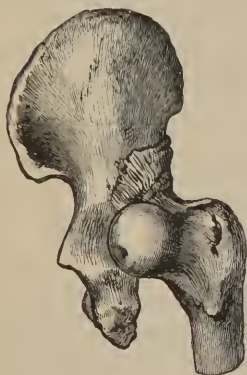
SPECIAL DISLOCATIONS.

Space will not permit the discussion of all the dislocations. Sufficient has already been said in a general way as regards diagnosis and treatment which will apply to those dislocations which are omitted.

Describe dislocation of the hip.

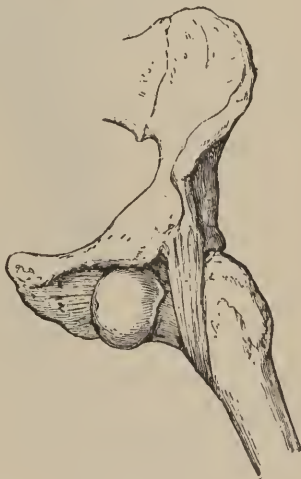
This means separation of the head of the femur from the acetabulum. There are three main varieties: 1. *Dorsal*, in which the head of the femur points backward, and may be situated on the dorsum of the ilium (Fig. 60), or lower down just posterior to the acetabulum (Fig. 61); 2. *Thyroid* (Fig. 62), in which the head is in the thyroid foramen. 3. *Suprapubic* (Fig. 63) in which the

FIG. 61.



Low Dorsal Dislocation.

FIG. 62.



Thyroid Dislocation.

head looks inward, and is placed on the horizontal ramus of the pubes. In all these varieties the ilio-femoral or Y-ligament is supposed to be intact.

FIG. 63.



Suprapubic Dislocation.

What are the symptoms of these dislocations ?

The special symptoms are as follows :

Dorsal : the limb is rotated in, flexed, and adducted. It is also shortened. The head of the femur may be felt in its abnormal position.

Thyroid : slight outward rotation, abduction, and flexion are the attitude of the limb. There is some lengthening.

Suprapubic : position ; slight abduction, some extension, and marked outward rotation.

What is the method of reduction ?

Increase the deformity, and then reverse the motions, Thus,

FIG. 64.

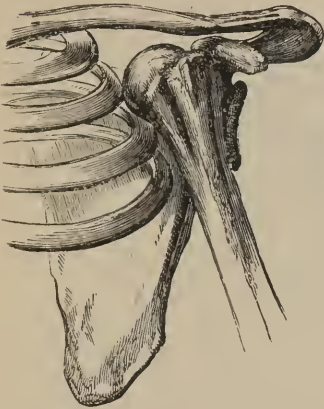
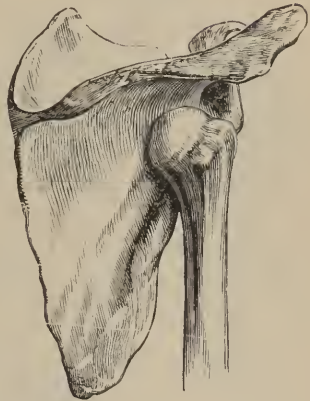


FIG. 65.

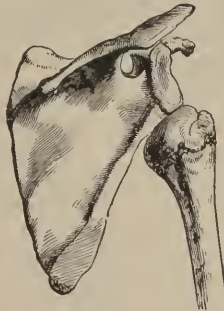


"Subcoracoid" Dislocation of Humerus.

Post-glenoid Dislocation of Humerus.

Dorsal: flex, rotate in, and adduct. Then quickly rotate out, abduct, and extend.

FIG. 66.

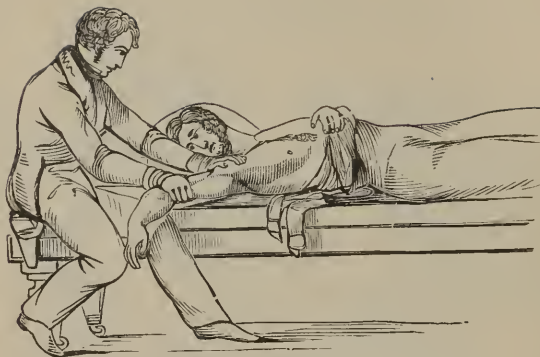


Subglenoid Dislocation of Humerus.

Thyroid: rotate out, abduct, and flex ; rotate in, adduct, and extend.

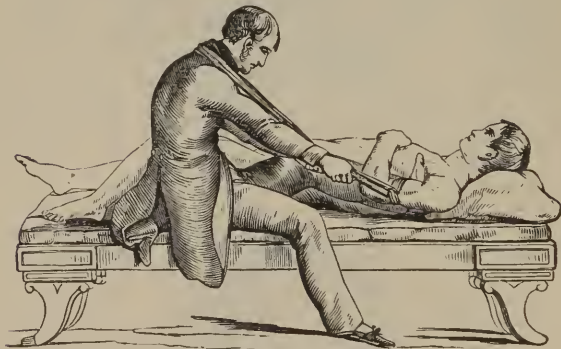
Suprapubic: rotate out, abduct, and extend ; rotate in, adduct, and flex.

FIG. 67.



Reduction by vertical traction (Cooper).

FIG. 68.



Reduction by the heel in the axilla (Cooper).

Describe dislocation of the shoulder.

This is the separation of the head of the humerus from the glenoid cavity of the scapula. The dislocation may be above, below, in front, or behind this cavity (Figs. 64, 65, 66). All are rare except the anterior varieties, and must be treated by traction. The anterior dislocations are best represented by the *subcoracoid*, which can usually be reduced by Kocher's method. (See also Figs. 67, 68, 69).

What are the symptoms of subcoracoid dislocation of the humerus?

Flattening of the usual contour of the shoulder; prominence of the acromion process; abduction of the limb, and inability to press the elbow against side of the body; presence of head of humerus under coracoid process; inability of the patient to place his hand on the opposite shoulder palm downward, or on back of head; shortening, shown by measuring from acromion process to external epicondyle in abduction, and by comparison with same measurement on the sound limb held in the same position.

What is Kocher's method of reduction?

Grasp the hand and elbow and rotate outward, the elbow being flexed to 90° and held *close* to the side of the body. Then, still keeping up outward rotation, bring the lower end of the humerus forward and inward across the body as far as possible, quickly rotate inward, and extend. The elbow should be kept *close to the body* during these manœuvres (Figs. 70, 71, 72).

FIG. 69.



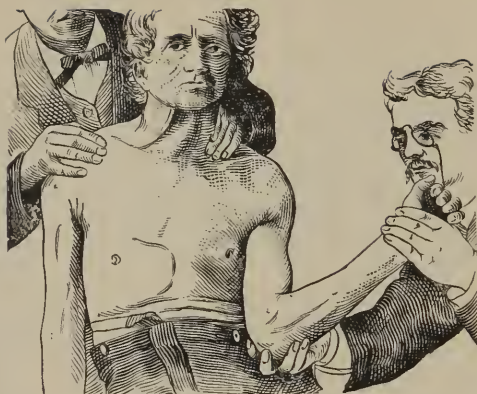
Supracoracoid Dislocation. (Albert.)

FIG. 70.



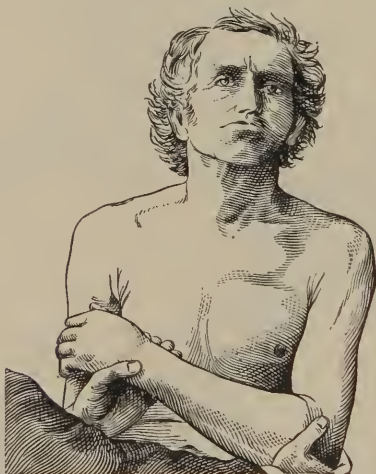
Kocher's method of reduction by manipulation; 1st movement, outward rotation (Ceppi).

FIG. 71.



Kocher's method of reduction ; 2d movement, elevation of elbow (Ceppi).

FIG. 72.

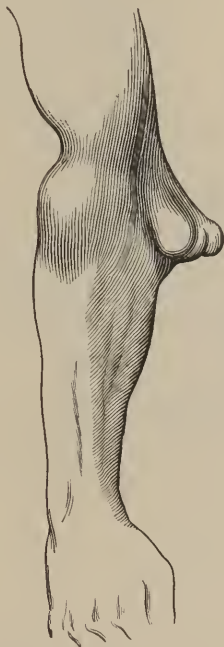


Kocher's method of reduction ; 3d movement, inward rotation and lowering of elbow (Ceppi).

Describe dislocation of the elbow.

The radius and ulna may be dislocated together or each bone separately, and in either case the direction of the displacement may be lateral, anterior, or posterior (Fig. 73). The most common dislocation of the elbow is both bones backward.

FIG. 73.



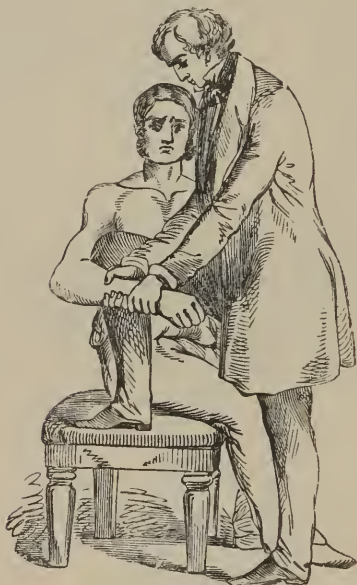
Complete outward dislocation (Denucé).

What are the symptoms of backward dislocation of radius and ulna?

Partial flexion of the elbow; slight passive flexion and extension; olecranon process and head of radius distinctly felt *posterior* to their normal relations to the epicondyles of the humerus; trochlear surface of humerus very prominent anteriorly. In *fractures*

of lower end of humerus the relations of the epicondyles to radius and ulna *are retained* (Fig. 74).

FIG. 74.



Reduction of dislocation of the elbow backward (Hamilton).

Reduction is effected by sudden downward traction, sometimes necessarily preceded by forced extension of the forearm.

Discuss dislocation of the thumb.

The most common is that of the metacarpo-phalangeal joint, in which the phalanx is displaced backward and upward up over the head of the metacarpal bone. Reduction is effected by direct traction, preceded by hyper-extension if necessary. At times reduction is rendered impossible on account of the flexor brevis pollicis. The two tendons of insertion of this muscle are slipped back, one on each side of the head of the metacarpal bone, and thus embrace it, so tightly at times, that an open operation may be necessary in order to effect reduction (Fig. 75).

Discuss dislocation of the inferior maxilla.

The condyles, one or both, are usually displaced forward on one or both of the eminentiæ articulares. Reduction is effected by

FIG. 75.



Backward Dislocation of Proximal Phalanx of Thumb, showing metacarpal head thrust through and held by heads of short flexor muscle (Agnew).

pressing, with the thumbs in the mouth, against the coronoid processes downward and backward, while the rest of each hand, grasping the angles, presses forward and upward.

Backward dislocation is comparatively rare, and usually involves fracture of the external auditory meatus.

INFLAMMATIONS OF BONE.**Give a general description of bone inflammations.**

The inflammations which attack bones are the same in every respect—exudation, causation, etc.—as those which affect the soft parts. The *apparent* difference, as regards the actual *lesion*, is due entirely to the presence of the mineral salts, which mix with the ordinary products of inflammation and give them their characteristic

hardness or grittiness. Were it not for these salts the products of bone inflammation would be identical with those of cellulitis. Bone is, in fact, connective tissue, and the mineral salts are not to be considered as taking part in the inflammatory process. They are inert matter necessarily mixing with, as just said, the products of inflammation. For example: An *acute* bone inflammation kills an area of bone tissue by destroying its blood-supply, etc. Were there no mineral salts in this area, it would be absorbed or remain as a mass of gangrene or detritus, just as in acute cellulitis. But the salts in this area give it hardness and consistency sufficient to resist absorption, and thus we have remaining a mass of bone gangrene or *necrosis*. On the other hand, a *chronic* bone inflammation infiltrates a given area of bone tissue and destroys it in a molecular manner—breaks it up, as it were, instead of killing a large area at once. Similarly, absorption of this destroyed tissue would result as in cellulitis, but again the mineral salts share in this disintegration, and the result is a gritty mass of bone-particles which is called *caries*.

What is osteomyelitis?

This is the general name for *all* varieties of bone inflammation. The marrow, hard tissue (compact and cancellous), and periosteum are the three elements of bone. It is found that they are *all* more or less involved in any bone inflammation, even when the process is chiefly located just beneath the periosteum. Hence the general name *osteomyelitis*. *Periostitis*, or inflammation of the periosteum, is really a superficial osteomyelitis, in which the periosteum also and necessarily takes a share.

What are the general varieties of osteomyelitis?

Osteomyelitis, like other inflammations, may be *non-specific* or *specific*, and each of these may in its turn be *acute* or *chronic*. Of the non-specific varieties, *suppurative* osteomyelitis is the most important.

Describe suppurative osteomyelitis.

This is generally *acute*. In this form it may extend throughout the entire bone or be circumscribed. If the latter it is usually limited more or less to the region of the epiphyseal line. It is then often called "epiphysitis," and is the form most common in children. "Epiphysitis" of the upper extremity of the femur rapidly involves the hip-joint unless promptly treated, and is often

known as "acute hip disease." In long bones the inflammation, when diffused, may occur "idiopathically," or as the result of a wound, especially compound fractures.

What is the course of acute suppurative osteomyelitis?

If untreated, the pus breaks through the bone, burrows through the soft parts, and reaches the surface. This may occur in more than one spot, and thus we have a series of *sinuses*. At the same time, in the bone itself more or less extensive areas of necrosis are formed. The process now becomes *chronic* suppurative osteomyelitis, and cannot be cured until the areas of necrosis are removed by operation.

What is the pathology of acute suppurative osteomyelitis?

It is practically that of an acute abscess (which see). The difference is due entirely to the peculiar structure of bone, and is essentially as follows: The "destructive inflammation" in an acute abscess, becomes in bone a *rarefying* osteomyelitis, which is the same process modified only by the fact of its occurrence in *bone*. Beyond this is, similarly, a "productive" *bone* inflammation or a *sclerosing* osteomyelitis, by which the bony tissue is thickened or increased in amount. Likewise in the centre is pus. Now, as the process advances, instead of there being a lot of detritus or broken-down tissue mingled with the pus, we have an area of *necrosis*, as already explained, around which the pus is extending. At the same time, the rarefying osteomyelitis beyond the pus gradually separates this area of necrosis from its connection with the rest of the bone, until finally this necrosed area becomes a separate movable mass which is called a *sequestrum*. The *involucrum* is simply the name given to the new bony tissue formed by the "sclerosing osteomyelitis." By this time the sinuses above referred to have formed, and the *holes* in the bone formed by the beginning of these sinuses are called *cloacæ*. Should the process occur on the surface of a bone, *superficial flakes* of necrosis are formed, and there is little or no involucrum except what may be formed by a productive periostitis. The terms *sclerosing* and *rarefying osteitis*, or *osteosclerosis* and *osteoporosis*, are sometimes used. They simply mean *sclerosing* and *rarefying* osteomyelitis respectively.

What is the pathology of other forms of osteomyelitis?

In *non-specific, acute*, and *non-suppurative* there is simply an effusion of serum and fibrin, with, possibly, some rarefying and scleros-

ing osteomyelitis, as secondary processes, the main process being called *serous* or *simple osteomyelitis*. It tends to resolution with or without the formation of necrosis. If the former, it is called "quiet necrosis," which is eventually absorbed by *fatty degeneration*.

Sclerosing and *rarefying* osteomyelitis may occur as primary processes. (See subjoined table of Bone Inflammations.)

Non-specific chronic osteomyelitis.—This may be serous or suppurative. If *serous*, it is simply the acute form become chronic, and if dead bone is produced, it is in the form of *caries*, which is similarly absorbed. If *suppurative*—this is much more common—it occurs in two forms: (a) as succeeding the acute after the formation of necrosis, sinuses, etc.; (b) as a *primary process*. In this case it is circumscribed, is at or near the epiphysis, and regular caries is produced. It is often called "chronic bone abscess." This process is the one which so often complicates or *secondarily infects* a focus of tubercular osteomyelitis. As a *primary* process it must not be confounded with this last.

The *specific* varieties of osteomyelitis, especially the tubercular and syphilitic, form each its own lesion in bone, just as they do in the connective-tissue planes, as already described. Here, again, we have the presence of the mineral salts mixed with the destroyed bone tissue, contributing to form *caries*. Thus we have a *specific* as well as a *non-specific caries*, each being the result of a corresponding chronic osteomyelitis. Either variety may occur deep in the bone or beneath the periosteum, in the latter case giving rise to "nodes," tubercular or syphilitic, as the case may be. At times syphilitic osteomyelitis may produce necrosis instead of caries, especially when seated in the bones of the skull. (See table for other varieties.)

What are the symptoms of osteomyelitis?

Non-specific Varieties.—The *general* symptoms are those of septicæmia, and they vary in severity according to that of the especial variety of osteomyelitis present. The *local* symptoms are *pain in the bone*, most intense of course when the inflammation is suppurative, and, as a rule, more severe at night; some enlargement of the bone. When sinuses form and reveal necrosis by means of the probe, the diagnosis is certain. The only difference between the acute and chronic varieties before the formation of sinuses is in the *intensity* of the *pain* and the *severity* of the *septicæmia*.

Specific Varieties.—These have their special general symptoms, tuberculosis, syphilis, etc. *Locally*, the symptoms are practically the same as in the preceding varieties. (See table below for further information.) *Tubercular osteomyelitis* is rare except as occurring near joints and as being a part of *tubercular arthritis*.

What is the treatment of suppurative osteomyelitis ?

Early diagnosis and prompt chiselling of the bone, both for the acute and chronic forms. If sinuses have formed, all dead bone should be removed by free incision and use of the chisel, gouge, or sharp spoon. The resulting cavity should be packed with iodoform gauze and allowed to heal by granulation. Or the skin-edges may be sutured, and the cavity allowed to fill with blood, which subsequently becomes organized. This is known as Schede's "blood-clot" method. If *non-suppurative*, wet dressings and careful regulation of the bowels will be sufficient. It must be remembered that this form may *run into* suppuration. Hence if the symptoms become severer or the process lasts for more than four or five days, operation should be resorted to.

Treatment of the Specific Varieties.—If tubercular, the focus should be removed as early as possible by operation. If syphilitic and *if it is secondarily infected with pus*, operation is indicated. Otherwise, use regular antisiphilitic constitutional treatment. It is understood, of course, that pure syphilitic osteomyelitis occurs in *nodes*, which are simply the well-known gummata of the bone.

Give a definition of caries and necrosis.

(a) *Necrosis* is a mass of dead bone of comparatively large size. It is the *result of* acute suppurative, of acute serous, or of sclerosing osteomyelitis. In the two last instances it is absorbable by fatty degeneration. In the first it must be removed by operation. Necrosis may also be caused by direct traumatism or by embolism of the regional artery.

(b) *Caries* is a mass of *minute particles* of dead bone. It is the *result of* chronic osteomyelitis, whether the latter be specific or non-specific. If non-specific, the caries is *non-specific*, and does not have pus mixed with it *unless* the osteomyelitis is *suppurative*. Tubercular caries and syphilitic caries are examples of *specific* caries. If uncomplicated, these varieties are often called *caries sicca*. (For other varieties of caries see table.)

The following table gives a brief synopsis of bone inflammations, and includes certain varieties which are not considered in the text:

VARIETIES OF OSTEOMYELITIS OR BONE INFLAMMATION.

		NAME.	PATHOLOGY.	CAUSES.	REMARKS.
Non-specific.	Acute.	1. Suppurative.	Pus. Necrosis.	Wounds and sepsis of <i>all</i> kinds. Phosphorus. Mercury.	A <i>physiological</i> variety always occurs in uncomplicated repair of simple fractures, and is followed by "productive" osteomyelitis. (See text.) This may at times cause <i>nodes</i> under the periosteum.
		2. Serous.	Lymph, serum, and fibrin. Quiet necrosis.	Contusions. Neighboring inflammations.	
Non-specific.	Chronic.	3. Suppurative.	Pus. Caries.	Same causes.	As is seen, this is really a "productive" bone inflammation. Palpation shows increased thickness and hardness. There is usually pain.
		4. Serous.	Same as No. 2.	Same causes.	
		5. Sclerosing (2 kinds).	(a) Excess of bone tissue and lime-salts. More compact tissue than cancellous. Quiet necrosis possible. (b) Hypertrophy of bone. Normal proportion between compact and cancellous tissue.	Any primary bone inflammation. If primary itself, then due to overlying ulcers or pressure. (c) Congenital. Overuse, as fibula from loss of tibia.	
		6. Rarefying (3 kinds).	(a) Purely secondary to main processes. (b) Absorption of bone tissue and lime-salts = <i>Atrophy</i> . (c) The same. <i>Caries simplex</i> is formed and absorbed.	(a) Any one of the <i>main</i> varieties of osteomyelitis. (b) Old age. Disuse. Insanity. (c) Pressure, as from an aneurism. Joint-neuropathics. Physiological.	

(c) Physiological. This process goes on in the absorption of the temporary callus in repair of fractures.

Specific.		Chronic.	
7. Rheumatic (periostitis aluminosa).	Periosteum chiefly affected. Serum thickened = "mucin." It may be diffused or occur as circumscribed masses. As in No. 2.	Rheumatic diathesis.	The bone affected has general superficial pain or painful spots. Other symptoms of rheumatism may be present.
8. Syphilitic.		"Secondary" syphilis.	Soreness in the bones. Yields to treatment.
9. Tubercular.	Part of an <i>acute general tuberculosis</i> .	"Tuberculous."	This is rare, and is hardly ever met with surgically.
10. Syphilitic.	Syphilitic tissue and <i>caries sicca</i> , if uncomplicated by pus.	Syphilis.	Part of the "tertiary" stage of syphilis.
11. Tubercular.	Tubercle tissue. Caries sicca if without pus. If not near the joints, subperiosteal nodes are often present. (See text.)	Tuberculous.	This is the regular surgical disease.
12. Osteitis deformans.	This is really a form of productive osteomyelitis. It is called "specific" simply because of its peculiarity. No especial microbe is known. There is an <i>excess</i> of bone tissue formed, but the <i>lime salts</i> are absorbed. Hence the bones become enlarged, soft, and as a consequence deformities occur, which may become permanent later on when the process ceases and the salts are redeposited.		
13. Osteomalacia.	Occurs chiefly in pregnant women. Severe general rheumatic pains, sweating, and excess of lime-salts in the urine. The bony tissue is the seat of a rarefying osteomyelitis, and the lime-salts are absorbed. No especial microbe. Bones of the pelvis chiefly, though not exclusively, affected.		
14. Rickets or rachitis.	A disease of childhood. It is really a "productive" chondritis of the cartilage in the epiphyseal line. The lime-salts are absorbed. Bony tissue fails to form in proper amount. Hence softness of bones and deformities.		
15. Acromegalia.	A rare form of sclerosing osteomyelitis. Somewhat similar to myxedema in general appearance. Age, between twenty and thirty. Either sex. Course, ten or twenty years. All the bones are in time affected. They become enormously enlarged, heavy, and unmanageable, the articular ends especially so. Hence the joints are useless. Spinal curvatures occur. Ribs thicken and thorax is deformed. Face is distorted from enlargement of facial and skull-bones. The muscles atrophy, though at first of increased strength. Skin tense and somewhat thickened. There is also some hypertrophy of the connective-tissue planes.		

Discuss Pott's disease.

This is *tubercular osteomyelitis* of the bodies of the vertebræ. It occurs usually in children. The bony tissue is gradually replaced by tubercle tissue, and softening results, causing various deformities of the spine, especially the so-called *angular curvature*, or a flexion of the spine due to coalescence of the vertebral bodies, which produces undue prominence of the *spines*. Recovery with ankylosis may take place at this stage, but more commonly "tubercular pus" forms (see Chronic Abscess and Tubercular cellulitis), which burrows more or less extensively and may burst spontaneously. *Psoas abscess* and *retropharyngeal abscess* are examples of collections of pus complicating Pott's disease. Death may follow soon or not for years.

What are the symptoms of Pott's disease?

Pain in the affected region, with *rigidity* (and *inability of self-sustainment* rapidly following), extremely marked on movement and pressure; *deformity*; and later, the symptoms of the abscess if it forms. Paralysis, both motor and sensory, of the nerves running from the vertebræ affected may occur in extreme cases.

What is the treatment of Pott's disease?

Rest and immobilization by means of the plaster jacket, jury-mast, and other apparatus. Should an abscess form and danger of spontaneous opening be imminent, it should be opened and drained. Otherwise it may be left alone, though some recommend incision in any event or injection with iodoform emulsion.

DISEASES OF JOINTS.

Give a general description of joint inflammation.

As is known, the structures which make up a joint are bone, cartilage, ligaments, synovial membrane, and, in some cases, fibrocartilage. Hence a joint inflammation is an inflammation of *all* of these structures. This is called *arthritis*. The inflammation may begin in any one of the above-mentioned parts, but sooner or later all are involved. The synovial membrane, however, when inflamed seems to prove an exception to this rule; that is, inflammation may or *may not* extend from it to the rest of the joint. If such an extension takes place, we have an arthritis, as already stated. If the inflammation *remains confined to the synovial membrane*, it is called a *synovitis*. Thus we have *two* main classes of joint inflammations—viz. the varieties of *synovitis* and the varieties of *arthritis*.

How are synovitis and arthritis respectively classified?

The varieties of synovitis and arthritis are the same as those of inflammation of bone or other part of the body—*i. e.* they are specific and non-specific—and each of these in its turn may be acute or chronic.

Compare briefly the symptoms and lesions of arthritis and synovitis.

Lesions.—In synovitis there is but one inflammation—*i. e.* that of the synovial membrane. In arthritis there is a combination of inflammations—*viz.* osteomyelitis, synovitis, chondritis, and cellulitis (of the ligaments).

Symptoms.—Other things being equal, those of arthritis are more severe than those of synovitis, both local and general. The latter, of course, are simply those of septicæmia, and are of a varying degree of severity. The *local* symptoms, common to both synovitis and arthritis, are *pain, tenderness, swelling, heat, redness, loss of function, and pain on passive and active motion.* A differential diagnosis is based on *two* points—*viz.* the *character of the swelling and bony crepitus.* Thus, in *acute* cases, if the swelling is marked so as to give *fluctuation*, and if there is no thickening nor infiltration of the tissues surrounding the joint, the process is probably a *synovitis.* If, on the other hand, the swelling is evidently due to inflammation of the ligaments and peri-articular connective tissue, shown by boggy feeling and readiness to pit on pressure, and if the bones are somewhat enlarged, it is an *arthritis.*

In *chronic* cases, if on passive motion or on crowding the ends of the bones together *bony crepitus* is obtained, the process is of course an *arthritis.* This symptom is sometimes obtained in acute cases, and is equally significant of *arthritis.* This *crepitus* must not be confounded with that due to exudation of fibrin, which is common in both synovitis and arthritis.

Other points of differential diagnosis must be obtained from the previous history, causation, number of joints involved, etc.

In *tubercular arthritis* the process may have *begun* either in the synovial membrane or in one or other of the ends of the bones, as a *tubercular synovitis* or *tubercular osteomyelitis* respectively. If in the former, the process may remain *as such.* If in the latter, extension to the joint sooner or later invariably takes place.

Discuss in detail the various varieties of synovitis and arthritis.

This rather comprehensive question may be answered by reference to the following tables :

VARIETIES OF SYNOVITIS.

NAME.	PATHOLOGY.	CAUSES.	SYMPTOMS.	TREATMENT.
1. Serous.	Exudation of serum; synov. memb. swollen.	Traumatism, external or from floating cartilage; neighboring inflammations.	All as given in text; fluctuation marked. Joint in flexed position when practicable. If used, "patella floats." Constitutional symptoms may be present.	Rest. Ordinary cotton applied with bandage. Wet dressings may be used or frequent applications of <i>hot</i> water.
2. Catarrhal (purulent or serofibrinous).	Sero-pus, fibrin. Synov. memb. much swollen.	The same as for the above, but which often precedes this form.	The same as in No. 1, but more severe, except less fluctuation. Septicæmia very pronounced.	The same as for No. 1. If, as is very possible, No. 3 develops, then treat as below:
3. Suppurative.	Pus; synov. memb. greatly swollen and congested.	Wounds or the preceding varieties and their causes.	Very severe local symptoms; marked septicæmia. Fluctuation.	Early and free incision and drainage. Otherwise suppurative arthritis will develop and destroy the joint.
4. Serous (hydrarthrosis or hydrops articulari).	Serum; synov. memb. thickened by productive inflammation, and often covered with hypertrophied villi. At times serum may be scanty (rare).	Often preceded by No. 1; it may be "idiopathic."	It is monarticular. Marked swelling and fluctuation. No pain, through aspirator or troicar and canula, or by heat, nor redness, but usually loss of function. No septicæmia.	Evacuate and wash out (1:30 carbolic acid) through aspirator or troicar and canula, or by small incision and drainage-tube. Long-continued pressure by rubber bandage, etc. may be first tried.
5. Fibrinous ("dry" or fibrino-plastic synovitis).	Synov. memb. somewhat thickened and covered by fibrin.	Rarely primary. Usually preceded by No. 1 or No. 2.	Knee most commonly affected. Pain on going up or down stairs, especially under and either side of ligamentum patellæ. Fibrinous crepitation on palpation. No other symptoms.	Rubber bandage; mas- sages; blisters applied on each side of the patella; on elastic knee-cap, etc. It is often difficult to cure. No operative treatment is indicated.

Non-specific.

Chronic.

Acute.

Acute.	6. Rheumatic (the "mild" form of acute rheumatism).	Serum slight; + the lesion of No. 5; cartilages opaque.	Exposure to cold, dampness, etc., or "idiopathic" — i. e. rheumatic diathesis.	Resembles an arthritis; skin red and edematous; general symptoms severe; recovery common; not so in acute rheumatic arthritis. This = main point in differential diagnosis. Same joints as the arthritis (which see).	Rest. Antirheumatic remedies: salicylic acid, salophen, etc.
	7. Gouty (the "mild" form of acute gout).	Similar to the above + urates in the synov. memb. and the exudation.	As above. Also excess in diet. "Uric-acid diathesis."	See Gouty Arthritis, of which, clinically, this is simply a less severe form.	Colchicum, etc. Recovery common.
	8. Gonorrheal (a form of gonorrheal rheumatism).	Same as in No. 2 + gonococcus.	Gonorrhea.	Similar to those of No. 2, except that usually more than one joint is affected — i. e. both knees or both ankles. More rarely one joint. Often severe general symptoms. One, usually large joint, resembles No. 4. A rather rare affection.	Various ointments: mercurial, ichthyl, belladonna, etc. Treat the urethritis.
Chronic.	9. Syphilitic.	Much dark-colored serum. Synov. memb. thickened with rounded infiltration.	Syphilis (secondary).	(a) Resembles No. 4. Absence of traumatism.	Antisyphilitic.
	10. Tubercular (three kinds).	(a) Exactly like No. 4, except + bacilli of tuberculosus. (b) = (a) + formation of tubercle tissue in the synovial membrane. (This form may or may not have "rice-bodies.") (c) No exudation.	Tubercule bacillus. Tubercule bacillus. Tubercule bacillus.	(a) Resembles No. 4. Absence of traumatism. (b) Ditto. Creptation if plus rice-bodies.	As in No. 4. Also long-continued immobilization.
	("Pulpy degeneration," "fungous arthritis")	Synov. memb. entirely replaced by tubercle [with especial tissue, which fills joint-reference to the knee-joint].	Tubercule bacillus.	(c) Passive motion not very painful; muscular spasms rare; pulpy feeling on palpation; no pain in bone; comparatively slight atrophy of soft parts; loss of function present or absent. This form may run into Tubercular Arthritis, which see.	(c) Open the joint and carefully dissect away all the tubercle tissue. This is "Synovial arthrectomy."

Specific.

VARIETIES OF ARTHRITIS.

NAME.	PATHOLOGY.	CAUSES.	SYMPTOMS.	TREATMENT.
1. Simple or non-suppurative.	All joint structures affected with a serous or sero-fibrinous inflammation; some blood-stained effusions of neighboring tissues. Also the serum in joint cavity; synovial membrane resembles granulation tissue. Possibly some pus as in synovitis No. 2.	Synovitis Nos. 1 or 2; traumatism; loose cartilage; inflammation; some blood-stained effusions of neighboring tissues. Also the serum in joint cavity; synovial membrane resembles granulation tissue. Mentioned below.	Septicæmia fairly well marked; local symptoms: see text. "Fluctuation slight." "Starting" pains. Recovery suppurative or chronic arthritis (No. 3).	Absolute rest. Wet antiseptic dressings. Unless recovery occurs the disease becomes suppurative or chronic arthritis (No. 3).
2. Suppurative.	Same as above except pus is the exudate. All articular structures are finally destroyed or atrophied. In the <i>bone ends</i> is of course a suppurative osteomyelitis. Result = bony ankylosis.	Simple acute arthritis or a synovitis, especially supplicative. Direct sepsis through a wound or from a neighboring inflammation, or, at times, from general diseases, as smallpox, scarlet and typhoid fever, etc. Pyæmia.	Very <i>intense</i> local symptoms. Skin red. Marked cedema. Fluctuation. Recovery without bony ankylosis never occurs. Hence importance of maintaining most useful position of the joint. Very severe type of septicæmia is present.	Free incision and drainage. Bone operation may be necessary.
3. Simple or non-suppurative.	Same as in No. 1. Serum may be increased or diminished. If of long standing, fibrous ankylosis may result.	This is simply No. 1 become chronic. It is rarely primary.	Slight septicæmia may persist. Locally as in No. 1, but less severe. Full recovery possible.	Rest followed by massage, friction, passive motion, etc. This only <i>after</i> complete subsidence of exudation.
4. Rheumatic (the severe form of acute rheumatism).	Changes similar to but more marked and extensive than those of rheumatic synovitis. Cartilages somewhat eroded and velvety. Ligaments thickened. Recovery rare. Ankylosis or chronic rheumatic arthritis = usual result.	Rheumatic synovitis or any of its causes.	Similar to but more severe than those of rheumatic synovitis. Rarely <i>monarticular</i> , if so, usually in a large joint and never in "great toe." Usually <i>polyarticular</i> , several joints, large or small, being simultaneously involved.	Same as that of rheumatic synovitis.

Acute.

Non-specific.

Chronic.

Specific.
Acute.

Specific.		Acute.		Chronic.	
5.	Gouty (the severe form of "acute gout").	Deposits of urates in all the joint structures. Ligaments thickened. Recovery fairly common. Otherwise process becomes chronic, finally ending in ankylosis. When <i>chronic</i> it closely resembles No. 7. Nodules of urates may be felt beneath the skin.	Gouty synovitis or any of its causes.	Locally those of a severe arthritis. Also general symptoms. If <i>monarticular</i> , usually in metatarsal-phalangeal joint of great toe. If <i>polyarticular</i> , then in the smaller rather than the larger joints.	Same as that of gouty synovitis.
6.	Gonorrhœal (a form of gonorrhœal rheumatism).	Practically the same as in simple arthritis + the gonococcus. Recovery fairly common. Otherwise it becomes chronic and ankylosis may ensue.	Gonorrhœal synovitis or it may be primary.	The same as but more severe than those of gonorrhœal synovitis. Often red lines on the skin. Same joints as the synovitis.	See gonorrhœal synovitis.
7.	Rheumatic (chronic rheumatism).	With a variable amount of serum, the other lesions are practically a combination of those of synovitis Nos. 4 and 6, and arthritis No. 4. Adhesions may form as result of excess of fibrin.	See Arthritis No. 4. May be primary.	Pain, swelling, loss of function. Same joints as in the acute. Constitutional symptoms often absent.	Rest, followed by massage, friction, active and passive motion, etc.
8.	Osteo-arthritis (rheumatoid arthritis; rheumatic gout; arthritic deformans).	Practically as in No. 7 and in addition great deformities due to sclerosing osteomyelitis of the bone ends, causing uniform enlargement or <i>osteophytes</i> . Cartilages eventually destroyed. Synovial membrane greatly thickened and becomes almost cartilaginous. Muscular atrophy and destruction of tendons. Ankylosis = final result.	Same as in rheumatism, which may precede. Or it may be due to a neurosis or a specific microbe.	Great deformity and impairment of function. Very slow course. Rarely acute. Usually <i>polyarticular</i> , and in the smaller joints or two or three of the larger ones. In hip or knee if <i>monarticular</i> . No constitutional symptoms.	No immobilization, but motion, massage, and friction. General tonic treatment. Counter-irritants. The iodides.

VARIETIES OF ARTHRITIS.—(Continued.)

NAME.	PATHOLOGY.	CAUSES.	SYMPTOMS.	TREATMENT.
9. Tubercular (if in knee = "white swelling").	Tubercle tissue forms in all the joint structures, generally starting from and in the ends of the bones, in which caries sicca results. Bony expansion may occur. Pus infection may take place and the pus may burrow, break, and thus form sinuses.	Tubercular synovitis or tubercular osteomyelitis.	Joint uniformly enlarged. Other symptoms are the <i>opposite</i> of those given under tubercular synovitis (c), except that loss of function is always present.	Immobilization, or injection with iodiform solution or arthrectomy.
10. Syphilitic (rare).	As above in No. 9, except for tubercle tissue substitute syphilitic tissue, also bony nodules may be felt around the joint.	Secondary, usually tertiary.	Monarticular; resembles No. 9; usually in one large joint. <i>Pain</i> is characteristic. Previous history important. May resemble any chronic arthritis.	Antisyphilitic. Immobilization. No operation unless pus infects and causes sinuses and necrosis.
11. Neuropathic (Charcot's disease).	Rapid rarefying osteomyelitis of the ends of the bones, so rapid as to cause, often, fragments of necrosis rather than caries. Ligaments and cartilages are destroyed. Onset may resemble synovitis, No. 4.	Changes in anterior cornua of spinal cord. (See Locomotor ataxia in any standard work).	Commonly the knee, one or both. No pains. Crackling obtained on palpation. Sometimes dislocation occurs.	Protect the joint as much as possible.

Specific.
Chronic.

What is understood by "hip disease"?

This is tubercular arthritis of the hip-joint, and may begin either as a tubercular synovitis or tubercular osteomyelitis. It is rarely diagnosed as such in its *synovial* stage.

What are the symptoms?

At first *pain* and *disability in the joint*, especially indicated by *lameness*. These symptoms should always cause suspicion, for although in themselves they may be indicative of only a non-specific synovitis, still, they may be the first symptoms of tubercular arthritis, and *rest in bed* with more or less immobilization, with careful observation, should at once be instituted. *Pain in the knee* is especially significant.

How is the diagnosis made of a well-developed tubercular arthritis?

Pain, often "*starting-pain*" at night, is severe; *disability* is absolute; *marked rigidity* of the *adductor muscles*; *passive motion* in all directions *limited* and *very painful*, especially *rotation*. *Position of the limb*: it is abducted and rotated out, but later on becomes flexed rotated in and adducted. Ankylosis of the joint is shown by endeavoring to straighten the limb, the patient lying on his back, when at once there is a *forward curve* of the *spine* in the *lumbar region*. Shortening is usually present, and is determined by methods already given. In very advanced cases there is actual dislocation. Often bony crepitus is felt. The constitutional symptoms may or may not be marked. Atrophy of the muscles and shortening of the gluteo-femoral crease should be observed.

What is the chief complication of tubercular arthritis?

The process may limit itself under treatment, and a cure—it may take years—with or without ankylosis be effected. More commonly, however, "pus" forms (true or "tubercular"; see Chronic Abscess and Tubercular Cellulitis), which burrows and bursts through the skin with resulting sinus or sinuses, which are also lined with tubercle tissue, an extension from the joint disease.

What is the treatment for tubercular arthritis?

In Children: Absolute rest and immobilization, best brought about by one or other of the numerous orthopædic contrivances now in use and which permit moving about. Otherwise, rest in bed with plaster-of-Paris spica or Buck's extension. Should pus form, authorities differ, some urging immediate incision and drain-

age, or even excision of the joint; while others merely enlarge the openings of the sinuses and keep on with the conservative treatment.

In Adults: Operative treatment is indicated whether pus has formed or not. The joint may be excised, or trial first be made of injection, after incision down to the capsule, of iodoform emulsion, zinc-chloride solution, balsam of Peru, etc. In excision the after-union is by means of fibrous tissue forming between the acetabulum and end of the femur.

What is ankylosis?

Ankylosis means a stiff joint, or a stiff joint may be said to be *ankylosed*. The degree of stiffness depends on the kind of ankylosis, of which there are three varieties:

Fibrinous.—This is due to the formation of fibrin, which results in adhesions between the joint-surfaces. This formation of fibrin may result from certain of the milder forms of synovitis or from too prolonged immobilization in the treatment of fractures or synovitis.

Fibrous.—A pre-existing arthritis may result in the formation of *fibrous tissue*, uniting the ends of the bones. Such an arthritis is usually non-suppurative.

Bony.—The arthritis is severe, usually suppurative or osteo-arthritis, the joint-surfaces of the bones are destroyed, and actual bony union between them is the result.

What is the treatment?

Fibrinous.—Under ether the adhesions should be broken up and passive motion continued until normal function is restored.

Fibrous.—A more or less limited function may be restored by the same treatment as the above. Perfect restoration is never possible. More often it will be necessary to excise the tissue.

Bony.—If the joint is in the best possible position—*i. e.* straight for the knee and at right angles for the elbow—no treatment is indicated. If in a faulty position correction by operation is called for.

What is floating cartilage?

This means a “loose body” inside of a joint, the knee being practically invariably the joint affected. These bodies are usually single, and are derived from various sources, as follows: The “floating cartilage” may be (1) a piece of one of the semilunar fibro-cartilages detached by traumatism (rare) or by inflammation (very

rare); (2) a piece of the articular hyaline cartilage covering the ends of the bones, detached by similar causes; (3) one or more of the villi of the synovial membrane which has become hypertrophied through chronic synovitis and broken off by traumatism; or such a villus may be attached by a long pedicle; (4) a blood-clot; (5) a mass of fibrin; (6) a detached osteophyte of osteo-arthritis.

What are the symptoms of floating cartilage?

These are due to the catching of the cartilage between the bony surfaces of the joint while in motion, which causes sudden stoppage, usually of extension, and sharp sickening pain. Such attacks may be of frequent occurrence or with long intervals. An attack may terminate by the cartilage slipping out of the way itself, or by the patient forcibly flexing and extending his own joint (very painful and rarely done). Usually outside aid is necessary; the leg is grasped with both hands, and is suddenly snapped into the extended position after a previous quick flexion which serves to loosen the cartilage.

Between the attacks the cartilage may be felt on careful palpation, which confirms the diagnosis.

What is the treatment?

There is none except removal through an incision into the joint. If, as sometimes occurs, an entire fibro-cartilage, usually the internal, is loosened, it gives rise to the same symptoms. In this case suture of the cartilage through an incision into the joint is indicated. If this fails, removal of the cartilage should be performed.

What is genu valgum?

This is commonly called "knoek-knee." It is a condition of hypertrophy of the internal condyle of the femur, which results in throwing the tibia outward from the normal line. In young children the limb may be straightened gradually by suitable apparatus. As a rule, however, and always in adults, *osteotomy* is necessary in order to straighten the limb. This operation is performed by *chiselling through* either the condyles or the shaft of the femur immediately above the condyles, after a preliminary one inch incision, longitudinal or transverse, through the soft parts, made immediately above either the external or internal condyle. The limb is then straightened and put up in plaster of Paris for six or eight weeks.

Bow-legs are treated in a similar way, the incision being over the site of the greatest deformity.

Discuss club-foot.

This is deformity of the foot due to distortion of one or more of the joints entering into its formation—*i. e.* from and including the ankle-joint down. The generic name is *talipes*, of which the varieties are—

- | | | |
|--------------------|---|----------------------------|
| 1. Talipes equinus | { Heel raised ;
Hyperextension of | { ankle-joint and
toes. |
| 2. " calcaneus | { Heel lowered ;
Extreme flexion of ankle-joint. | |
| 3. " varus | { Inversion of entire foot ;
Weight borne on outer edge. | |
| 4. " valgus | { Eversion of entire foot ;
Weight borne on inner edge. | |
| 5. " equino-varus | —A combination of 1 and 3. | |
| 6. " equino-valgus | —A " " 1 " 4, rare. | |
| 7. " planus | —Flat-foot. | |
| 8. " cavus | —A foot excessively arched. | |

Of these varieties talipes equino-varus is the most common (Figs. 76, 77, 78, 79, 80, 81, and 82).

What are the causes of club-foot ?

They are congenital and acquired, and in either case there may be *paralysis* of the muscles which are the "antagonists" of those in whose line of contraction the deformity exists; or *traumatism*. The paralysis may be cerebral or spinal. By "traumatism" is

FIG. 76.



Pes varus in the adult (Treves).

FIG. 77.



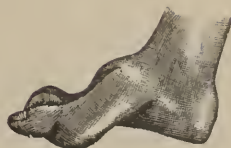
Pes calcaneus. The foot before and after section of the tendo Achillis (Treves).

FIG. 78.



Pes planus, or flat-foot (Treves).

FIG. 79.



Pes cavus, or hollow-foot (Treves).

FIG. 80.



Talipes equinus.

FIG. 81.



Talipes varus. From King's College Museum.

FIG. 82.



Pes valgus (Adams).

meant:—(a) faulty position which remains uncorrected in utero (congenital traumatism);

(b) *Cicatricial contraction* of the muscles in whose line of contraction the deformity exists (acquired traumatism), induced by inflammation following wounds, etc.

What is the treatment, in general, of club-foot?

In young patients restoration to the normal position is best brought about by manipulation and application of proper apparatus. In older patients or in whom the parts are rigid, tenotomy of the contracted tendons may be necessary, or even an open operation whereby all tendons and ligaments opposing reduction are cut; or even resection of bones may be advisable. Plaster-of-Paris bandage is the after-treatment of such cases.

What are hammer-toe and hallux valgus?

The *former* is a condition of extreme *flexion* of the second phalanx and *extension* of the first of one or more of the smaller toes. Tenotomy or excision of the joint or amputation is the treatment.

Hallux valgus is extreme abduction of the great toe at the metatarso-phalangeal joint. Excision of the joint or *osteotomy* of the metatarsal bone, with subsequent straightening of the toe and application of a plaster-of-Paris bandage, is the treatment.

What are the principal deformities of the spinal column?

Lateral curvature, or *skoliosis*; curvature forward (concavity looking backward), or *lordosis*; curvature backward (convexity looking backward), or *kyphosis*. The last two occur in the lumbar region as a rule, and are rather rare except as complicating some other process, as rickets, acromegalia, Pott's disease, etc. *Skoliosis*, on the other hand, is very common as a primary affection, and begins in youth. The general health is not necessarily affected, nor is there any inflammation of the vertebræ. The column is simply weak and bends laterally in various ways. The intervertebral disks are compressed, and there is *rotation* of the *bodies* of the vertebræ on one another, so that their *anterior surfaces* look toward the *convexity*, while the *spines* of the vertebræ look toward the *concavity* of the curve.

What are the causes?

Muscular or nervous weakness or habitual faulty position, or the

deformity may be secondary to some definite disease of the vertebræ, of the back muscles, or of the central nervous system.

What is the treatment?

Uncomplicated primary scoliosis is treated by systematic massage and exercise of the muscles, both passive and active, all under careful supervision. Diet and general hygiene are also important.

Discuss excision of joints.

There are various ways of performing "arthrectomy," or excision of a joint, even for one joint. For the *knee*, a flap of skin and fat should be raised U-shaped, the lowest part on a level with the tubercle of the tibia and each extremity reaching to the corresponding tuberosity of the femur. The quadriceps extensor is then cut through and the joint opened *above* the patella, which is turned down and removed. Extreme flexion is now made, and a slice sawed off from the femur and tibia, whose raw surfaces are now approximated by straightening the limb and held in position by silver-wire sutures or steel nails. The wound is closed and the limb enveloped in plaster of Paris for eight weeks. The result, of course, is a perfectly stiff limb from the hip to the ankle.

For the other joints the best average incision is the long straight posterior one, through which the joint is opened and the bony surfaces removed.

INJURIES AND DISEASES OF TENDONS BURSÆ AND MUSCLES.

What are the causes and symptoms of rupture of tendons and muscles?

Sudden strain, violence, powerful muscular contraction as in tetanus. Rupture of a muscle or tendon is accompanied by a sharp pain, disability, ecchymosis, and a groove or depression at the site of rupture.

What is the treatment?

Rest and approximation of the edges. In severe cases open the tissue above the rupture and suture the torn structure; put the limb in an immovable splint.

What is the treatment of incised and lacerated wounds involving tendons and muscles?

The parts should be placed in a position to relax the muscles and the divided tendons and muscles sutured. In suturing tendons the proximal end should be overstretched, so as to bring the ends together. Tendon that has retracted into its sheath should be pulled down or the sheath opened. If the upper end of a torn tendon cannot be found, the lower end should be united to a neighboring tendon or muscle.

What are the causes of dislocations of tendons and muscles?

Sudden strains brought to bear on a tendon passing around a bony prominence, as the long head of the biceps of the arm or the peroneal tendons.

What is the treatment?

Reduction by relaxation of the muscle and a fixation dressing. In obstinate cases fixation by sutures, or even tenotomy, may be called for.

What are the causes of teno-synovitis, or inflammation of the tendon sheaths?

Wounds, traumatism, or it may complicate rheumatism, syphilis, or gonorrhœa.

What are the symptoms of fibrinous teno-synovitis?

Pain, disability, swelling, and a peculiar crepitation on palpation and motion of the affected tendons. This is the most common form of the acute non-specific varieties. (See under cellulitis.)

Describe the treatment of teno-synovitis.

Rest, warmth, and pressure; hence apply cotton and immobilize.

Describe tubercular teno-synovitis.

The lesions are precisely the same as in tubercular *synovitis* (which see). It should be treated by incision or removal if only a mass of tubercle tissue exists.

What is a thecal cyst or ganglion?

It is form of cystic tumor found in connection with the tendons about the wrist or ankle. The symptoms are much like those of chronic bursitis. They occur most frequently as tense elastic

globular swellings. They are protrusions of the synovial linings of the tendon sheaths or of the joints.

What is the treatment?

Subcutaneous rupture by pressure or subcutaneous puncture with a tenotome.

What forms of inflammation are found in connection with the bursæ?

The varieties of bursitis are the same as those of synovitis.

What are the causes of bursitis?

Acute bursitis is caused by injury. Chronic bursitis occurs as a result of long-continued pressure and irritation.

What are the symptoms?

The symptoms of *acute bursitis* are those of acute inflammation, with swelling and distension of the sac with effused fluid. Suppuration may supervene, with involvement of the surrounding cellular tissue.

Chronic bursitis is more common than the acute form and is attended with less pain; the sac becomes distended and thickened, forming a fluctuating tumor. The formation of a bursal tumor over the metatarso-phalangeal joint of the great toe is known as a "bunion"; over the patella, as "house-maid's knee."

What is the treatment?

In the acute form rest, elevation, and cooling lotions. In the subacute forms a blister is advisable. If suppuration occurs, free incision, evacuation, and drainage is called for.

The chronic form should be treated by counter-irritation and elastic pressure; in obstinate cases aspiration, followed by the injection of carbolic-acid solution or a solution of iodine. Opening the sac and packing with antiseptic gauze, or excision of the sac is sometimes required.

INJURIES AND DISEASES OF THE CIRCULATORY SYSTEM.

What is the surgical treatment of pericardial effusion when attended with dangerous symptoms of heart failure?

Aspiration of the pericardial sac. The needle should be inserted

in the fifth intercostal space, just above the sixth rib, two to two and a quarter inches to the left of the median line of the sternum. Complicating pulmonary effusion should be aspirated first.

HEMORRHAGE.

What is hemorrhage?

The escape of blood from the blood-vessels; it may be spontaneous or traumatic. When the blood does not appear on the surface, but escapes into the adjoining connecting tissue, the term extravasation or subcutaneous hemorrhage, or hæmatoma, is used.

What are the anatomical varieties of hemorrhage?

1. *Arterial hemorrhage*, when the blood comes from an artery; the flow is rapid and in spurts *synchronous with each beat of the heart*. The color is bright red, except in partial or complete asphyxia.

2. *Venous hemorrhage* (from a vein) occurs as a *steady even* spurt of dark-colored blood, and is not affected by the heart's action.

3. *Cupillary or parenchymatous* hemorrhage occurs as a steady oozing, and the blood is less red in color than that from an artery.

What are the clinical varieties of hemorrhage?

1. *Primary*, when the hemorrhage follows immediately after the receipt of an injury;

2. *Intermediary*, not occurring till after the reaction from shock, and happening before the lapse of twenty-four hours.

3. *Secondary*, occurring between the end of the first day and the complete cicatrization of the wound. It may be due to the sloughing of a contused vessel, to traumatism, atheroma, or septic processes. Constitutional conditions, as hæmatophilia, pyæmia, septicæmia, chronic renal or hepatic diseases, may interfere with nature's reparative processes and retard the cicatrization of a wounded vessel, so that hemorrhage supervenes.

What is hæmatophilia?

In some persons a constitutional tendency or hemorrhagic diathesis exists, so that a profuse, uncontrollable hemorrhage may result from the most trifling lesion, or the hemorrhage may even be spontaneous.

How is the tendency combated?

Saline laxatives, iron, ergot, lead, opium, and quinine are recommended. Operations are to be avoided.

What is nature's method of temporarily arresting arterial hemorrhage?

When an artery is completely divided immediate *contraction* and *retraction* of each divided end occurs. The *inner* and *middle* coats eurl up within the lumen, making a sort of transverse partition, above which is formed the *intravascular clot*. Below this partition, and extending out through the wound in the *outer* coat to the *sheath*, or *through it* when wounded, is formed the *extravascular clot*. When the hemorrhage has been severe, these processes are reinforced by an *increased tendency to coagulability* of the blood and *weakened cardiac action*.

What further changes may take place in the wounded artery which cause permanent healing?

When the bleeding has thus become temporarily arrested an exudation of inflammatory lymph occurs; the *process of repair* (which see) goes on in the coagula until finally they become organized into a permanent cicatrix, and the vessel remains as an imperious fibrous cord.

How is the process of temporary arrest varied, when the artery is partly but not completely divided?

Contraction and retraction of the vessel cannot occur: there is hemorrhage, and if it is *subcutaneous* coagulation takes place within and around the sheath, and the internal coagulum is continuous with the external. If the hemorrhage is *external*, there is no "natural" arrest and unless treated the patient bleeds to death.

What are the constitutional effects of hemorrhage?

When a large blood-vessel is opened, there is a profuse gush of blood, and death takes place almost immediately, preceded usually by syncope and convulsions.

When the hemorrhage is from a smaller vessel and is less profuse, its effects are shown by increasing pallor, feeble and rapid pulse, sighing respiration, cold and clammy skin, faintness and nausea, dilated pupils, restlessness, with noises in the ears and flashes of light before the eyes; the limbs become flaccid; there is a sense of suffocation, and unconsciousness supervenes. In this state, that of *collapse*, the patient may die or slowly recover. The

weak heart and lowered arterial tension give an opportunity for coagulation of blood to take place in the wounded vessels, and the bleeding is thus arrested. With the return to consciousness and an increase in the force of the cardiac contraction the temporary coagula may be forced out from the wounded vessel and all the symptoms of hemorrhage recur. This alternation of hemorrhage and spontaneous arrest may continue until exhaustion and death take place. Sometimes delirium, convulsions, and hemiplegia precede the final collapse. The loss of a given amount of arterial blood produces graver symptoms than the loss of the same amount from a vein: this is partly explained by the fact that venous blood is more or less an effete fluid. Recovery from severe hemorrhages is often attended with a febrile reaction known as "hemorrhagic fever," accompanied by a quick and frequent pulse, extreme restlessness of mind and body, and great thirst; sometimes chronic persistent anæmia results, and is extremely rebellious to treatment.

(For artificial methods of arresting hemorrhage see arrest of hemorrhage under Contusions and Wounds.)

What is the general or constitutional treatment of hemorrhage?

Where the immediate symptoms are severe, the patient should be placed in the recumbent posture and kept perfectly quiet, with the head lowered. If the syncope increases, whisky should be given internally and Esmarch's bandage should be applied to the extremities. This drives the blood toward the nerve-centres. The bandages should be removed gradually and within an hour. This process is called "auto-transfusion." This method is also indicated if the hemorrhage is internal and not accessible to operation. *

Ergotine hypodermatically, morphine, iron, quinine, gallic acid, and lead, all in full doses, have been recommended as internal hæmostatics, but they should not be relied upon.

When the more immediate effects of the hemorrhage are recovered from, the great thirst should be relieved by a very nourishing and fluid diet; tonics and stimulants should also be administered.

In cases of collapse or threatened death from hemorrhage.

Immediate infusion with a normal saline solution is imperative. The older methods of blood-transfusion by "mediate" or "immediate" transmission have been superseded by that of saline "infusion." In an emergency use a heaping teaspoonful of salt to a pint of boiling water. The solution may be injected into a vein or an artery, but preferably the basilic vein, which is exposed by

incision. In the cases where the symptoms are not so urgent the injection may be made into the subcutaneous tissues.

OF THE ARTERIES.

What is the effect of a contusion of an artery?

In slight contusion there is no pathological change produced in the vessel. In contusion of greater severity the vitality of the vessel may be altered, so that inflammation and thrombosis result and the vessel becomes obliterated; or from *intravascular* pressure on the site of a *limited contusion* a *traumatic* aneurism may develop; or the two inner coats may be lacerated, and the vitality of the outer coat so lowered that it subsequently gives way, causing hemorrhage and extravasation.

What is the result of a lacerated wound of an artery?

Complete laceration of a vessel causes the inner and middle coats to curl up and produce coagulation, as already described. This condition is generally unattended by immediate hemorrhage.

In *incomplete laceration* there is hemorrhage, which, if external, does not cease spontaneously; if subcutaneous, a *hæmatoma* results.

If the communication with the open artery persists there is formed an *arterial hæmatoma*, which is sometimes improperly termed "traumatic" or "diffused false aneurism."

What are the effects of punctured and incised wounds of arteries?

Non-penetrating wounds of arteries involving the outer coat or the outer and middle coats, are usually followed by secondary hemorrhage. Such injuries should be treated by ligation.

Punctured wounds, made with a very fine needle, are not apt to be followed by either immediate or secondary hemorrhage.

Incomplete transverse incised wounds allow more gaping, and consequently greater hemorrhage, than longitudinal wounds of the walls of an artery.

Oblique cuts hold an intermediate position.

Complete transverse incised wounds of an artery are followed by retraction and contraction, as in complete laceration, and are therefore less immediately dangerous than an incomplete incised wound.

What is the treatment of arterial wounds ?

The hemorrhage should be arrested. When the wounded artery is in the limbs, pressure by means of a rubber bandage or twisted tourniquet. This is a temporary expedient which affords time for cleansing and opening the wound and tying the bleeding artery. When the blood is welling up from a deep wound, temporary pressure with the finger will control the bleeding while the vessel is being seized and held with pressure forceps. When a vessel is incompletely severed, it should be completely divided and a ligature placed on each end.

When extensive *subcutaneous* extravasation has occurred, the main vessel of the limb should be controlled by elastic compression: this procedure should be followed by ligation of the main trunk above the wound, or the tumor should be laid open and the divided ends of the vessels sought for and tied.

When the bleeding can not be *controlled* by the Esmarch's bandage, an opening should be made in the tumor, of a size sufficient to admit the introduction of the finger, by which the bleeding vessel can be controlled until the vessel is ligated.

In some cases the finding of the wounded vessel in the disorganised tissues is a matter of great difficulty.

To what conditions of the arteries is the term "traumatic aneurism" properly applied ?

Following an *arterial injury* it may occur by—

1. Dilatation of the cicatricial tissue closing an arterial wound. When the wound in an artery is slight in extent, the wound may heal *without obliterating* the lumen, and *intra-vascular pressure* causes *dilatation of the cicatrix*.

2. Dilatation of the inner arterial coat through a wound in the outer coat.

3. Dilatation of the outer coat after rupture of the inner and middle tunics. In the latter case, when the vessel-walls have been weakened by *disease*, atheroma is an important factor in producing the aneurism, and it is *not* therefore *traumatic*.

What is the treatment of traumatic aneurism ?

Compression of the artery or ligation just above the sac.

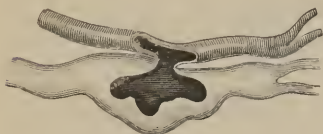
In the case of a small superficial aneurism it may be advis-

able to expose and remove it, and close the artery above and below by ligation.

What are the two forms of arterio-venous fistula?

A wound or inflammation may cause between an artery and adjacent vein a persistent communicating *fistula*, through which blood passes from the artery to the vein. When the blood passes directly from the artery to the vein, it is called "*aneurismal varix*," or *simple* arterio-venous fistula. When a *sac* is interposed between

FIG. 83.



First Form of Arterio-venous Fistula
(Wyeth).

FIG. 84.



Second Form of Arterio-venous Fistula
(Wyeth).

the artery and vein, the condition is called "*varicose aneurism*," or *sacculated* arterio-venous fistula (Figs. 83 and 84).

Describe the pathological anatomy and symptoms of aneurismal varix.

The vein and artery adhere and communicate by a round, smooth opening with thickened edges. From blood-pressure the vein-wall opposite the opening becomes dilated, thickened, and varicose, forming a pouch. The dilatation of the vein spreads above and below, even affecting its branches. The artery is dilated above, but narrowed below; the branches also become smaller. At the site of the disease there appears in the course of the dilated vein, a soft compressible tumor, which is the seat of a peculiar jarring, expansile, or vibratory pulsation and a characteristic purring or hissing murmur. Compression of the artery above arrests the pulsation and murmur; compression of the vein increases the size of the tumor.

The limb below the disease may be cold and œdematous, with a feeble circulation.

What is the treatment?

Compression, or, if this fails, ligation, of the artery above and below the communication with the vein.

What is the pathology of varicose aneurism?

This differs from the simple arterio-venous fistula in that, instead of the two vessels, artery and vein, cohering together directly, a sac or pouch is developed between them. This circumscribed sac may be formed by an inflammatory condensation of the connective tissue, or may be a regular aneurism. Through this sac the venous and arterial blood intermingle. Spontaneous cure is rare; enlargement and rupture may occur.

What are the symptoms and diagnosis?

In addition to the symptoms described as accompanying the direct form of arterio-venous fistula, there are others.

It is usually possible to detect a tumor lying between the vein and artery, or two tumors—one the dilated vein, and the other the intervening sac.

In addition to pulsation and bruit, there is usually a soft blowing *aneurismal* murmur. The vein and its branches are enlarged. (Edema, ulceration, and other nutritive changes are often present. The disease is progressive.

Describe the treatment.

Direct pressure or compression with Esmarch's bandage may be tried; if these means fail, ligation should be resorted to. The limb should be rendered bloodless, the sac laid open, and the artery and vein ligated above and below the tumor.

What are the varieties of arteritis?

The usual varieties of inflammation, specific and non-specific, each of which may be acute or chronic, affect the arteries.

What are the causes of arteritis?

1. Local injury; traumatism or impact of emboli;
2. Specific diseases; ordinary sepsis;
3. Alcoholism;
4. Senility.

Arteritis may be followed by (1) fatty degeneration; (2) atheroma; (3) calcification; (4) aneurism; (5) ulceration or perforation; (6) gangrene of the part supplied by the artery.

What are the pathological changes found in arteritis?

The inflammation may attack either tunic, but all are apt to become involved. The vascular wall becomes thickened and swollen, the vasa vasorum of the external coat engorged, and the tissues infiltrated with inflammatory corpuscles.

Atheroma is a general term for a *patch*, one or more of which appear in the vascular wall, and of which each is a result of a localized chronic arteritis. The process begins in the deeper parts of the intima, and may invade the other coats. The process extends inward, and appears as an ulcer on the inner surface of the intima. Such a patch may become the seat of fatty or calcareous degeneration.

Primary fatty degeneration is a process distinct from that of atheroma; it usually begins in the inner coat.

Emboli may be the cause, or a thrombus form as the result, of arteritis.

Suppurative arteritis may induce septicæmia or pyæmia. When suppuration occurs, perforation of the vessel, with fatal hemorrhage, is liable to ensue.

Inflammatory changes in the muscular and elastic fibres renders the vessel less able to resist the vascular pressure; hence fusiform aneurismal dilatation is liable to occur.

Arteritis may result from perivascular inflammation.

Syphilitic or other forms of arteritis may be associated with great inflammatory proliferation, leading to partial occlusion or complete obliteration of the blood-channel.

Describe the symptoms of arteritis.

The elasticity of the artery is diminished or lost, and it may be felt as a hard cord; pain, local tenderness and hyperæmia; impairment of power and lower temperature of the part supplied by the artery. With obliteration of the artery gangrene of the part may occur.

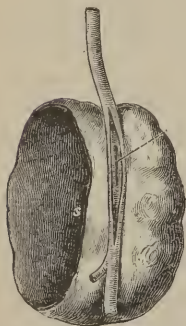
What is the treatment of arteritis?

If chronic, preserve the warmth of the limb by wrapping in cotton; if suppurative, incisions and drainage. Varieties of specific arteritis should receive their appropriate remedies. Precautions to prevent fatal hemorrhage from perforation and gangrene should be made.

Define true aneurism.

An aneurism is a circumscribed tumor formed by the dilatation of one or more of the arterial coats, induced by the distending force of the blood-pressure. There are two varieties: (1) the tubular or fusiform, and (2) the sacculated or sacciform.

FIG. 85.



Sacciform Aneurism from injury: the artery laid open to show opening into sac (Bryant).

A *fusiform* or spindle-shaped aneurism is one formed by dilatation or expansion of the entire circumference of an artery. Usually all the coats are involved.

A *sacculated* aneurism is a sac or pouch formed by dilatation of a part only of the circumference, consisting of one or more of the coats.

The fusiform aneurism is the rarer form; its usual seat is the arch of the aorta. As the middle part of the tumor is more dilated, this gives the aneurism a spindle shape. The walls of the artery are thickened, its growth is slow, and rupture finally tends to occur.

The sacculated aneurism (Fig. 85) is the most common variety, and is usually developed on one side of an artery, communicating with it by a narrow orifice. The aneurism wall usually consists of a fusion of all the coats of the artery.

What are the causes of aneurism?

Any agent lessening the resistive power of the vessel, hence arteritis and the changes induced by it, as atheroma and calcareous degeneration. Alcoholism, cardiac and renal disease, and advanced age are predisposing causes. Infective embolism from ulcerative endocarditis may cause aneurism. External violence or contusion may excite *arteritis*, and thus induce aneurism. "True" aneurism is caused by *disease*, "traumatic" aneurism by an *injury*; this constitutes the sole difference between the two varieties.

What are the pathological changes occurring in aneurism?

On dissection the sac is found to consist of—(1) an investment of condensed areolar tissue; (2) next is the true aneurismal sac, consisting of the external coat, thickened by interstitial growth, and the intima and media altered by inflammatory and atheromatous

changes; (3) within are concentric layers or laminæ of decolorized fibrin, the inner layers softer and redder as being more recently deposited from the blood.

The secondary changes produced by the aneurism are due to pressure on adjacent parts: erosion, œdema and varicosity or obstruction of the veins are induced; the nerves are irritated, as neuralgic pains, paralysis, anæsthesia, and aphonia from pressure of the recurrent laryngeal may be present; erosion of cartilage or bone or of the sac itself may occur. Gangrene from interference with the circulation, due to pressure or to an embolus of detached fibrin obstructing the vessels, is not unusual.

What are the symptoms of aneurism?

The *symptoms* usually develop gradually, especially the pressure-symptoms as above outlined.

The *special* symptoms characteristic of an aneurism are made apparent by palpation and auscultation: the presence of a tumor in the course of an artery; pressure on the main artery above the aneurism causes its pulsation to cease, and it diminishes in size and becomes less tense; pressure beyond the aneurism causes the tumor to become larger and more tense.

If the aneurism contain much laminated fibrin, it is hard and incompressible; when the fibrin is small in amount, it is soft and compressible, and may even fluctuate.

The pulsation is a peculiar expansile beat. The fluid contents of the aneurism transmit the impulse of the heart-pressure equally in all directions. The pulsation is less marked when the neck of the aneurism is narrow and it contains much laminated clot. Just after the pulsation a peculiar thrill or vibration or tremulous motion is felt by the hand placed upon the aneurism.

By placing the ear to the aneurism the bruit is heard: this is described as an intermittent blowing, sawing, or purring sound, and is synchronous with the aneurismal pulsation. When the orifice of the sac is small or the cavity nearly filled with laminated clot, the bruit is indistinct or absent.

How is aneurism diagnosed from other conditions?

Solid tumors, cysts, and abscesses lying over the course of an artery may have a transmitted pulsation from the latter, and thus simulate an aneurism. In such swellings (1) the pulsation is not expansile; (2) there is no bruit; (3) such a tumor may be lifted

away from the artery; (4) the size and tension of the swelling are not diminished by occlusive pressure on the artery.

Pulsating malignant tumors of bone of a sarcomatous or encephaloid nature may readily be confounded with aneurisms, but careful examination will show in such pulsating tumors that (1) the expansile pulsation is not so distinct; (2) the bruit is not so harsh; (3) history of the case will show that the pulsation and bruit have appeared late; (4) involvement of the lymphatic glands and other signs of malignant disease are present.

Aneurisms devoid of pulsation and those which have become cured by consolidation may be confounded with other tumors located near an artery.

What are the course and termination of an aneurism?

Untreated, the usual progress of an aneurism is to a fatal termination—(1) by pressure interfering with the function of some important organ; (2) by rupture; (3) by interfering with the circulation of a limb, producing gangrene; (4) by inflammation and suppuration of the sac itself. When aneurisms burst through a serous surface, the hemorrhage is rapidly fatal; when aneurisms burst upon a mucous surface, the opening is usually small, and death is preceded by several hemorrhages. Rupture upon a cutaneous surface takes place by a slow process of ulceration. Rarely a spontaneous cure occurs by a gradual deposition of fibrin filling the sac, leading to consolidation and a cure. Occasionally a spontaneous cure may occur by an embolus obstructing the vessel on which the aneurism is located, or by inflammation and coagulation within the sac. All of these processes are attended with danger.

What are the methods of treating aneurism?

Classified into (1) constitutional and (2) local.

The aim of all constitutional treatment is to produce a condition of coagulability in the blood, and to control the force of the heart and circulation so as to bring about a deposition of fibrous laminated clot in the aneurismal sac.

For “internal” or “inoperable” aneurisms constitutional treatment only can be employed, but it is also valuable in cases subjected to surgical interference. In this plan of treatment absolute rest of mind and body by the recumbent position in bed is essential, together with restricted diet and a limited quantity of fluids. The remedies used are iodide of potassium, iron, ergot, and infusion of digitalis.

Of the surgical procedures, describe ligation.

The artery may be tied on the cardiac side of the aneurism (Hunter's and Anel's methods) or on the distal side of the sac (Brasdor's and Wardrop's methods), or on both cardiac and distal sides (Antyllus's method), with or without extirpation of the sac (Fig. 86).

FIG. 86.

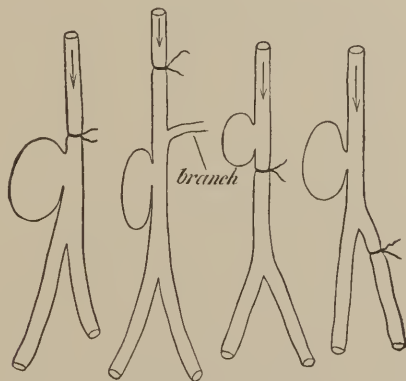


Diagram showing Anel, Hunter, Brasdor, and Wardrop Methods.

When the passage of blood through an artery is arrested by ligation, how is the part beyond supplied with blood?

The supply of blood to the part beyond is re-established by the *anastomosing branches* and capillaries above and below the site becoming dilated and intercommunicating more freely ("collateral circulation").

Describe the Hunterian method.

This consists in applying a ligature on the artery at such a distance from the seat of disease as will ensure a small branch being given off from the artery between the ligature and the aneurism. By this method the total current of blood through the sac is not cut off, and anastomotic circulation and reversal of current in the branch carries a small amount of blood into the main artery and through the aneurism. Deposition of laminated clots necessarily

ensues, instead of the formation of a soft clot, which would result from complete arrest of the circulation.

What symptoms occur at the time the ligature is tightened?

Complete arrest of pulsation in the sac; within a few hours pulsation again returns; this lasts for a few days, and then passes off as fibrinous clots are deposited and become solidified. The artery is gradually converted into a fibrous cord. The dangers attending ligation are (1) secondary hemorrhage at the point of ligation; (2) gangrene from obstruction of the venous circulation; (3) inflammation and suppuration around the sac.

Failure to cure occurs in certain cases, due to a too vigorous return of the anastomotic circulation or to the development of a secondary aneurism in a part of the diseased artery.

What is the after treatment?

Immediately after ligation the limb should be elevated, wrapped in cotton, and absolute rest enjoined. Should the recurrent pulsation persist, flexion of the limb and compression of the artery should be tried. If these means fail, ligation of the artery near the tumor, or opening the sac and ligation of all supplying vessels is required. If after ligation, *gangrene* is threatened, amputation is usually the only resource. Suppuration should be treated by applying Esmarch's bandage and opening the abscess.

When secondary hemorrhage has occurred, the safest procedure is to amputate at once. Occasionally reopening the wound and ligating above and below the former ligature are all that is necessary, but thereafter the case must be closely watched.

What are Anel's and other methods?

Anel tied the artery on the *cardiac* side, close above the aneurism, there being no intervening branch given off. The objection to this method are (1) the ligature is applied to a diseased or athromatous portion of the artery; (2) the blood-current is completely arrested, hence there is a soft clot formed.

Brasdor applied a *distal* ligature just beyond the sac. The objections to it are the same as to *Anel's* method.

Wardrop's is a modification of *Brasdor's* method, in that the *distal* ligature is so applied as to insure the existence of one or more branches between the sac and the ligature.

Ligature of the artery, both on the distal and cardiac side of the sac, is known as the "old operation" or the method of *Antyllus*,

who also opened the sac. This method, *with extirpation of the sac*, is a rational way to treat any accessible aneurism.

Describe the method of applying digital pressure.

Select a point in the course of the artery where it is not too deeply located and can be pressed against a bony surface. Relays of assistants are necessary, three in attendance at one time. One makes pressure, one notes the pulsations in the sac, and the other waits to relieve the first. The vein should not be compressed. A bag of shot resting on the compressing finger prevents tiring of the muscles of the compressor. The compression should be continuous and just sufficient to stop pulsations. Anodynes should be used if necessary.

Describe mechanical pressure.

When a sufficient number of assistants cannot be procured, one of the various forms of mechanical compression should be used. *Tourniquets* with two pads, so that pressure can be exerted on two parts of the artery alternately, are preferable; or a *bag of shot* may be left in position for about an hour and a half, and after its removal digital compression should be kept up for another twelve hours. The advantages of this method are its simplicity and rapidity.

The disadvantages of pressure in general are that it is apt to be so painful as to require anaesthesia. It is also liable to cause rupture or thrombosis of the arteries near the sac, or even rupture of the sac itself, and sometimes gangrene of the limb. In many cases it has failed to effect a cure, but has not prevented subsequent ligation.

The methods of treatment which have very justly fallen into disuse are galvano-puncture, massage or kneading, the introduction of horse-hair, catgut, or wire into the sac, and the injection of coagulating substances into the sac or surrounding tissues.

McEwen's method of introducing fine round needles into the sac, so as to cause scratching and irritation of its interior, has been attended with considerable success.

LIGATION OF ARTERIES.

Describe the general principles to be adopted in ligating arterial trunks in continuity, whether for injury or disease.

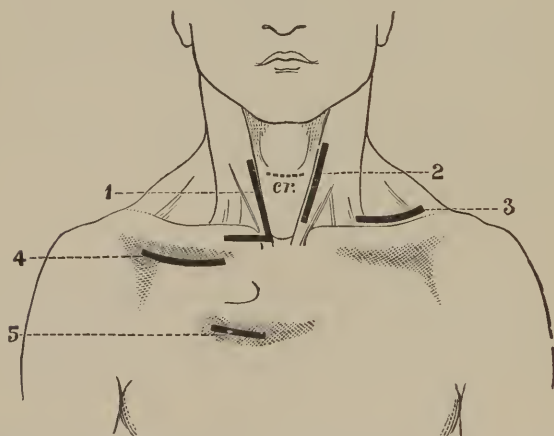
The exact line of the artery should be defined by its anatomical

landmarks. Its pulsations, if superficial, sufficiently mark out its course. All antiseptic precautions should be scrupulously observed.

The Incision.—The incision should be upon the line of the artery, freely and cleanly cut and of ample size. Incise the deep fascia by a clean cut in the line of the skin-incision. Keep the anatomical relations well in mind. The wound should be kept well open with retractors.

The exposure of the artery.—Seek for the artery with the finger. The fibrous sheath enclosing the artery and vein should now be opened, so as to expose a portion of the artery for the passage of the ligature. The artery should be distinguished from the vein and the nerve. It has a pinkish-white shining surface, and is firm, compressible, and elastic. The vein is larger, purplish, soft, flaccid, and thin-walled. The nerve has longitudinal markings, and feels like a solid, round, non-compressible cord.

FIG. 87.



Incisions for—1, innominate and roots of carotid and subclavian; 2, common carotid; 3, subclavian, third part; 4, axillary, first part; 5, internal mammary in second space; *cr.*, cricoid cartilage.

The artery is accompanied by one vein, or in the case of the smaller arteries by two—the *venæ comites*.

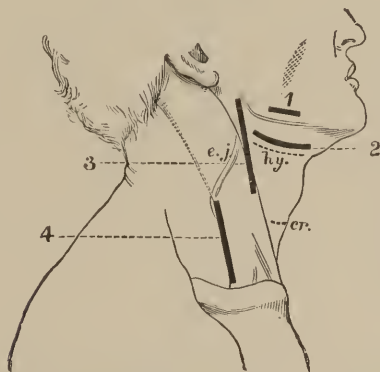
Passing and tying of the ligature.—Hold the sheath open with the forceps and pass an aneurism needle *between* the artery and the vein and *around* the artery; then the needle is threaded and withdrawn, carrying one end of the ligature with it. If the sheath is well opened, $\frac{1}{4}$ to $\frac{1}{2}$ inch, there is but slight danger of puncturing the vein. In tying the ligature, the two forefingers should meet on the artery at the point where the knot is being tied, and the strain exerted with these two fingers. The knot should be a reef knot. The ends should be cut $\frac{1}{4}$ inch from the knot.

The wound is now closed, and dressed in the usual manner. Absolute rest of the limb should be enjoined for a period of two to three weeks, varying with the size of the artery.

LIGATION OF SPECIAL ARTERIES.

A full consideration of this subject would take up too much

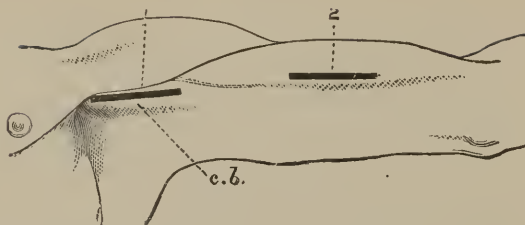
FIG. 88.



Incisions for—1, facial; 2, lingual; 3, external carotid; 4, vertebral; *hy.*, hyoid; *cr.*, cricoid; *e.j.*, external jugular.

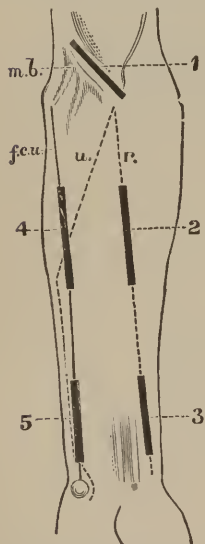
room. For all practical purposes a reference to figures 87–93 will indicate the incisions for the different arteries:

FIG. 89.



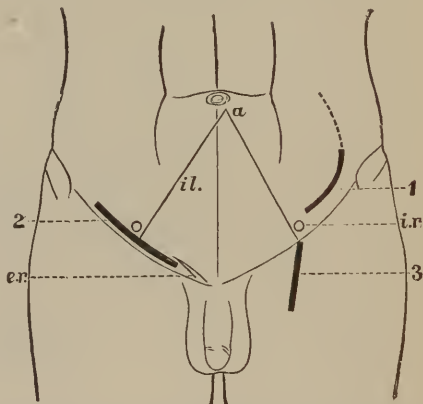
Incisions for—1, axillary artery, third part; 2, brachial artery at middle of arm; *c. b.*, the swell of the coraco-brachialis. The patient is lying, and the arm is seen from below.

FIG. 90.



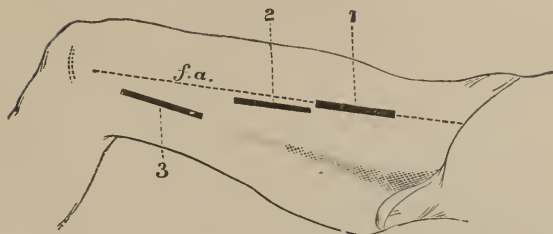
Incisions for—1, brachial at bend of elbow; 2 and 3, for radial in upper half of forearm and at wrist; 4 and 5, for ulnar at corresponding points: *m. b.*, median basilic and ulnar veins; *u.* and *r.*, lines of ulnar and radial arteries; *f. c. u.*, flexor carpi ulnaris. The tendons of the flexor carpi rad. and palmaris longus are indicated at the wrist.

FIG. 91.



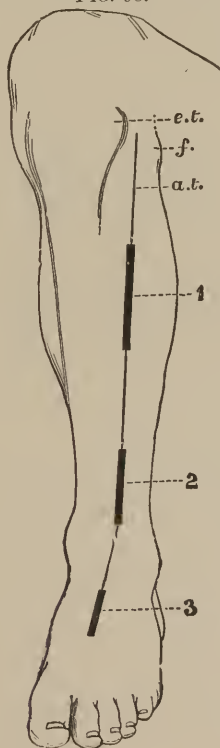
Incisions for—1, external and common iliac (Abernethy); 2, external iliac; (Cooper); 3, common femoral; *a*, point of splitting of aorta; *i. r.*, internal ring; *i. l.*, line of external and common iliac arteries; *e. r.*, external ring.

FIG. 92.



Incisions for—1, the femoral in Scarpa's space; 2, the femoral in Hunter's canal; 3, the popliteal; *f. a.*, the line of the femoral artery.

FIG. 93.



Incisions for—1, anterior tibial above middle of leg; 2, anterior tibial above ankle; 3, dorsalis pedis; *e. t.*, external tuberosity of tibia; *f.*, head of fibula; *a. t.*, the line of anterior tibial.

OF THE VEINS.

What are the injuries that may happen to a vein?

Contusions; lacerated, incised, or punctured wounds.

What is the effect of contusion of a vein?

Contusion of a vein may be *slight* and give rise to no ill consequences, or it may be severe, leading to rupture of its coats and extravasation of blood, which may be absorbed or may become encysted, forming a bloody tumor or *venous hæmatoma*. If bacteria gain access, inflammation and abscess may result.

The effect of *wounds* on veins is practically the same as on arteries, but, other things being equal, the amount of hemorrhage from a vein is less than from an artery of equal size, because the vein collapses, and the *vis a tergo* is less than the heart's action.

How is hemorrhage from a vein controlled?

Bleeding from large veins in an open wound can always be controlled by ligation, suture, or compression. Bleeding from the cerebral sinuses can be controlled by moderate pressure when the skull is already open, or trephining may become necessary. *Lateral ligation* or *suture* of a vein should always be attempted when possible in a large vein.

What dangers may arise from wounded veins?

Open wounds of veins in infected tissues or when surrounded by pus are especially liable to cause pyæmia or septicæmia; hence all veins in cases of sepsis should be closed by ligation of both ends.

Define thrombosis and embolism.

Thrombosis is the formation of a clot or *thrombus*. It may occur in arteries, but is far more frequent in veins. Its causes are traumatism; inflammation of the vein, artery or of surrounding tissues.

Embolism is the stoppage of an *embolus*. An embolus is a small foreign body floating in the blood-current. Its nature varies. Usually it is simply a small clot of blood broken off from a thrombus and carried away by the blood current. If from a *venous* thrombus, the embolus is not stopped until it passes into the arterial system. Hence *embolism* occurs, as a rule, only in *arteries*. *Occasionally*, however, an embolus may, on reaching the vena cava, *drop back* from gravity, and thus fall into a vein small enough to arrest it.

What other varieties of emboli are there ?

Besides blood-emboli there are emboli of *air, fat, masses of bacteria*, and *vegetations from the valves of the heart*. Those of *air* are caused by accidental wounding of the large veins in the neck, whose walls are usually prevented from collapsing by their intimate adhesions to the surrounding connective tissue. Death from heart failure at once or within an hour is the common result. A fat embolus is usually derived from the marrow of bones. Hence fractures, simple or compound, are the exciting causes. *Stimulation and infusion* are the only treatment for the resulting heart-failure.

What are the varieties and causes of phlebitis, or inflammation of veins ?

The varieties and causes are the same as those already given for arteries.

What is the pathology ?

Phlebitis is often accompanied by clotting of the blood within the vein, or *thrombosis*. The changes, occurring principally in the outer and middle coats of the vein, are the same as in arteries. Swelling and thickening of the vessel-wall, with loss of flexibility, necessarily occur. If the phlebitis is non-suppurative, the thrombus becomes organized with or without central absorption, and the vein remains with its lumen only partially obstructed or is converted into a fibrous cord.

Per contra, a thrombus due to traumatism may become septic and cause phlebitis.

Suppurative or gangrenous phlebitis (parts of the process in the corresponding varieties of cellulitis) leads to disintegration or "yellow softening of the clot," with the formation and separation of emboli, which drift with the blood into other parts of the circulation, and may produce infarctions or pyæmic abscesses.

What are the symptoms of non-suppurative phlebitis ?

In a superficial vein a hard knotty and painful cord, with the overlying skin of a reddish color, appears along the line of the vessel. Coagulation of the blood impedes venous return circulation, causing œdema, induration of the tissues, and stiffness of the limb. Neuralgic pain is present. More or less septicæmia is evidenced according to the severity of the phlebitis.

What is the treatment?

Absolute quiet and rest, wet antiseptic dressings. If suppurative cellulitis occurs, free incision, with a copious moist antiseptic dressing, is indicated.

To promote absorption of thickened tissue in the *chronic form*, elevation of the limb, friction, massage, and elastic pressure should be made.

What is the etiology and pathology of varicose veins?

With disease and degeneration of the vascular walls the veins become dilated, lengthened, thinned, and tortuous, producing *varix* or *varicose veins*. Varix may be found in any vein; its most common seats are the leg, spermatic cord (varicocele), pampiniform plexus, and rectum.

Degeneration of the muscular fibre from debility, heredity, continued standing, imperfect innervation, associated with any anatomical predisposing cause, as frequent gestation, are some of the factors in producing varicose veins.

Hyperplasia of the cellular tissue, irregular thickenings of the vein-walls, sacculation, and incompetent valve-action are some of the pathological conditions found.

Coagulation may take place within the vein, inducing phlebitis. Suppuration may occur. Calcareous degeneration of the clots, with the formation of phleboliths, is not infrequent; chronic inflammatory changes in the tissues around, leading to œdema, varicose ulcers, or elephantiasis, are apt to occur.

What are the symptoms?

Varix causes in the affected part a dull pain, a sensation of fullness or numbness, and disability.

When the vein is subcutaneous, the characteristic linear, bluish, knotted tumor is apparent.

When the deep veins are involved, the diagnosis is not so easy.

With varix of the leg of long standing œdema, eczema, and chronic ulcers may be present. Profuse hemorrhage may follow perforation of the vein from external ulceration.

What is the treatment of varicose veins of the limbs?

The palliative treatment consists in support and moderate pressure applied by means of a flannel roller bandage, elastic webbing, or rubber bandage and the plaster-of-Paris or silicate of sodium

cast. When ulceration and eczema exist, appropriate dressings, with elevation of the limb and rest in bed, are indicated.

Describe the surgical treatment.

The radical methods of treatment are—subcutaneous ligation, obliteration of the veins by acupressure pins, or open incision and ligation of the veins.

In *subcutaneous ligation* a straight needle armed with catgut is made to pierce the skin and pass *beneath* the vein, emerging at a point about an inch beyond the point of entrance; then the needle is made to re-enter the exit puncture and pass *above* the vein, emerging at the first puncture. When the two ends of the threads are drawn tight and tied, the loop encircles the vein beneath the skin and occludes its lumen. Each vein should be similarly ligated at a number of points.

Acupressure pins act in a similar manner. The pin pierces the tissues passing behind the vein, which is then compressed between the pin and a figure-of-eight ligature applied over two extremities of the pin.

Aseptic open incision of an inch or two, with ligation, is attended with no danger.

OF THE LYMPHATICS.

What is the surgical importance of a wound of the lymphatics?

As the lymphatics are found in every part of the body, some are necessarily divided in every wound. It is only when the *thoracic duct* or a large varicose lymphatic is wounded that such injuries demand special consideration.

What are the different forms of lymphangitis?

The various forms of inflammation already discussed also affect the lymphatics.

What is the pathology of non-suppurative lymphangitis?

The pathological changes resemble those occurring in phlebitis. The wall of the lymphatics becomes opaque and thickened, and dilatation or occlusion of the channels may occur. The lymph coagulates, forming thrombi, which occlude the vessels and may *subsequently* break down, and form pus. The surrounding connective tissue becomes infiltrated with inflammatory products, and oedema and induration occur; either the induration is absorbed or the pro-

cess may go on to suppurative cellulitis. Elephantiasis is due in part to lymphatic obstruction.

What are the causes and symptoms of lymphangitis?

Reticular lymphangitis (capillary network) occurs in *patches*, and the neighboring lymphatic glands are usually involved. Slight wounds of the hand, as needle-pricks, or even simple contact with septic matter without visible lesion, may lead to reticular lymphangitis. The single or multiple patches successively extending up the limb are red, hot, painful, and œdematous. The process may go on to the formation of pus or suppurative cellulitis.

Tubular lymphangitis (the long vessels) develops from similar causes. It is also associated more particularly with dissection wounds and snake-bites and erysipelas.

When the superficial vessels are affected, red cutaneous lines mark their course; each vessel can be felt as a hard thread. Pain, swelling, and œdema of the limb are present. The lymphatic glands are always involved.

Resolution occurs in seven to ten days or suppurative cellulitis supervenes. More or less septicaemia is usually present with both reticular and tubercular lymphangitis.

The disease is diagnosticated from phlebitis by the associated glandular implication and absence of "large cords."

What is the treatment of lymphangitis?

Wounds should be cleaned and disinfected. Antiseptic dressings should be applied along the course of the lymph vessels. Free and early incisions should be made to evacuate pus.

Constitutional treatment as for septicaemia.

What are the causes and pathology of lymphadenitis?

Inflammation of a lymphatic gland may occur independently or as a complication of lymphangitis. Its sieve-like function leads to the absorption and retention of septic bacteria. Hence the varieties of lymphadenitis are the same as of inflammations in general.

What are the symptoms of acute and chronic lymphadenitis?

Acute.—Heat, swelling, pain, and tenderness. The surrounding connective tissue becomes implicated, and the skin assumes a red glazed appearance. If *suppurative*, fluctuation is present; and if untreated spontaneous evacuation of pus finally occurs, with a prolonged period of healing and cicatrization. If *serous*, resolution occurs or pus *supervenes*.

Chronic.—*Tubercular* lymphadenitis, with burrowing of pus and the formation of sinuses, takes place in untreated cases; an example of mixed infection. Tubercular lymphadenitis without pus is accompanied by swelling and induration with, later on, degenerative softening and without pain and fever. The inguinal bubo occurring with the initial lesion of syphilis is a form of *syphilitic* lymphadenitis. (Suppurative lymphadenitis greatly resembles ordinary acute abscess.)

What is the treatment of lymphadenitis?

Applications of moist antiseptic dressings. When pus has formed, incision, curetting, and drainage by packing. Sinuses and fistulae should be treated in the same way. When a tubercular gland has become caseous, but no fistula or abscess has formed, complete excision is indicated.

What is lymphangioma?

A tumor formed almost entirely of dilated lymphatic vessels.

AMPUTATIONS.

What is an amputation?

The removal of a projecting organ or extremity from the body. The term is usually applied to the removal of an extremity in part or in whole.

Mention the principal varieties of amputation.

Single, when one or part of one extremity is taken off; *double* or *multiple*, when two or more (or parts thereof) are taken off at one sitting. Amputation in *continuity* when through the substance of a bone; in *contiguity*, when through an articulation.

As regards time, amputations are *primary*, *intermediary*, and *secondary*. *Primary* amputations are those performed soon after injury, before the onset of fever and sepsis; or for pathological causes. *Intermediary* amputations are made during the inflammatory stage. *Secondary* are performed after the subsidence of the fever, during the stage of suppuration. The *time of election* is during the primary period if shock can be subdued and the condition of the patient will permit operation. The secondary period should next be selected, except in cases of acute sepsis and spread-

ing gangrene, which call for immediate operation, as these conditions admit of no delay.

What are some of the conditions that call for amputations ?

Avulsion ; crushing ; compound fracture and dislocations ; lacerated, contused, and poisoned wounds ; gangrene from traumatism and occluded arteries ; destructive disease of bones and joints ; malignant tumors ; deformities ; aneurisms ; and secondary hemorrhage.

What are the conditions contraindicating amputation ?

Shock, nephritis, alcoholism, diabetes, tuberculosis, pyæmia, and atheromatous degeneration, unless extenuating circumstances render operation imperative. In gangrene, excepting the "spreading" and traumatic forms, the surgeon should wait for a *line of demarcation* before operating.

What consideration should decide the site of the amputation ?

The point at which the amputation should be made is determined by the nature and extent of the injury. As a rule, no more of the limb should be sacrificed than is absolutely necessary, excepting in case of the lower extremity, where, in order to form a stump serviceable for locomotion, it is sometimes necessary to sacrifice part of the limb ; there are certain points of election that give a more useful stump. It is sometimes desirable to make the amputation through healthy tissues, so as to secure primary healing of the wound ; this is especially the case in operations for long-standing and exhaustive disease. Here the saving of a few inches of limb is of *secondary* importance.

What instruments are required for an amputation ?

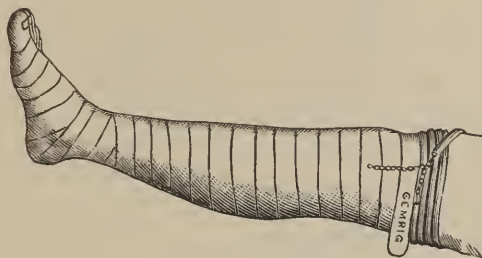
In addition to the instruments needed for an ordinary operation, an amputating knife and a large flat saw and a metacarpal saw are required ; also cutting bone-pliers and bone forceps, Esmarch's apparatus or a tourniquet, and muslin retractors. The retractors are used to cover and hold the tissues when sawing the bone ; they are made from pieces of muslin 6 inches wide, torn through half its length, so as to make two or three tails, the latter used when two bones are to be divided.

How is hemorrhage controlled during an operation ?

By means of a tourniquet, Esmarch's apparatus, or digital compression.

Esmarch's apparatus (see Fig. 94) consists of a broad rubber bandage and a flattened rubber band with an eye and hook for fastening. The objectionable vasa-motor paralysis and oozing of

FIG. 94.



Esmarch's Apparatus.

blood following the use of the rubber bandage can be obviated in part by not applying it too tightly, and removing it as soon after the operation as possible. When abscess, gangrene or malignant tumors are present, a bloodless condition should be secured by elevation of the limb and a simple tourniquet only.

Digital compression of the *main artery* by a skilled assistant is a very good method of controlling hemorrhage during an amputation.

Describe the principles to be observed in performing an amputation.

The flaps should be smoothly and evenly cut, so arranged that the resulting scar shall neither be over the bone end nor so placed as to interfere with the wearing of an artificial limb. There should be no tension on the flaps. A safe rule is to cut them so that their combined length shall be twice the diameter of the limb, and their combined width should equal the circumference. They may be of equal size, or one long and the other short, and, as a rule, should be one on the anterior and the other on the posterior surface. Hanging tendons should be cut off short. The bone should not be splintered in sawing or in trimming the ends.

In cutting the flaps, which consist of skin and the subcutaneous tissue down to the deep fascia, the method of cutting from without inward by dissection is the best. Flaps so made can be fashioned

with precision and accuracy. The main vessels can be divided transversely instead of being slit up, as is often done in the transfixion method.

The flaps to cover the stumps should be carefully planned. It is well to outline the intended incision on the limb before the operation is done. The making of a periosteal flap to cover the end of the sawn bone has nothing to recommend it. In sawing the bone press the thumb-nail of the left hand into the bone just above the saw line, and rest the saw blade against the thumb knuckle. At first draw the saw lightly from the heel to the point. Divide the bone by long slow cuts. Where there are two bones, the smaller and more movable one should be divided first. The limb should be steadily held by an assistant. For the smaller bones a fine saw should be used.

In arresting the bleeding the main vessels are secured immediately after the sawing is completed. After the pressure on the main vessel is relaxed the smaller vessels may be secured. Persistent oozing should be checked by hot water, torsion, or continuous pressure. The wound is then sutured and dressed so as to obtain primary union.

SPECIAL AMPUTATIONS.

What rule should be observed in all amputations of the fingers?

It is a cardinal principle in all amputation for injury *to remove as little of the digit as possible*. The operation usually reduces itself to a mere trimming of mangled parts. The bone should be divided as low down as possible. The combined length of flaps for the fingers should be one and a half times the diameter of the finger. *The best place for the scar is on the dorsum*. The fibrous sheath for the flexor tendons may be closed by sutures.

Describe disarticulation of the fingers or thumb at the metacarpophalangeal joint.

Commence the dorsal incision just above the head of the metacarpal bone, and continue it down in the median line beyond the base of the phalanx. The cut now sweeps obliquely around the base of the digit, to join the first on the dorsal aspect by a transverse incision in the crease between the finger and the palm. Divide the tendons and lateral ligaments, and complete the disarticulation. The head of the metacarpal bone is then removed

unless the patient's occupation is one of manual labor (Figs. 95 and 96).

FIG. 95.



Removal of Head of Metacarpal Bone (Druitt).

Describe disarticulation at the elbow.

By an elliptical flap is best. The highest point of the ellipse is over the prominence of the olecranon; the lowest point is on the

FIG. 96.



Amputation of Thumb with its Metacarpal Bone: line of incision (Druitt).

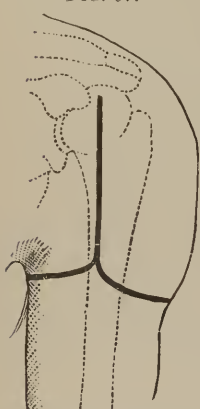
anterior surface, a little above the middle of the forearm. By an incision commencing at the olecranon sweep downward and around the arm to the lowest point of the ellipse, and then upward and across the border to the starting-point. Retract the skin and divide

the muscles obliquely by transfixion half an inch below the joint. Disarticulate from the outer side.

Describe the method of amputating the arm.

Where there is insufficient room to apply Esmarch's apparatus hemorrhage may be controlled by compressing the axillary artery against the first rib, or by Keen's method: A compress is placed above the clavicle, and a rubber bandage is passed over it and alternately between the thighs and in the opposite axilla. The circular method is well adapted for the lower part of the arm; the antero-posterior flap is better for the upper part.

FIG. 97.



Amputation through Shoulder-joint: lines of incision for modified oval method. (Smith.)

Describe the method of amputating at the shoulder.

Abduct the arm slightly and steady the skin. Commence the incision just below and in front of the acromion process, and carry it down the arm for four inches, piercing the deltoid to the bone. Now carry the knife over the inner side of the arm, not going lower than the lowest point of the vertical incision; thence behind and around the external aspect of the arm to the starting-point (Fig. 97). Isolate and divide the tendons of the great pectoral, coraco-brachialis, and biceps, and then secure the axillary artery. Divide the remaining muscles and disarticulate.

Describe the operation for the removal of the upper limb with the scapula and outer two-thirds of the clavicle.

The clavicle is exposed by an incision along its upper surface, divided, and separated from its attachments. The subclavian vessels are then secured between two ligatures. In making the antero-inferior flap commence at the centre of the clavicular incision, carry the knife across the anterior part of the axilla and inner surface of the arm, and then downward and inward to the inferior angle of the scapula. Join this latter point by an incision starting from the outer end of the clavicular incision and passing over the dorsum of the scapula. Dissect up the flaps, divide the muscular attachments of the scapula, and secure all bleeding vessels.

Disarticulation of the GREAT TOE at the metatarso-phalangeal joint may be done as in the fingers or thumb at the corresponding joints.

Describe Lisfranc's operation.

For the *dorsal* flap, the cut begins just behind the tubercle of the fifth metatarsal bone, thence along its outer border for an inch, it then sweeps across the dorsum, parallel to and one half an inch beyond the tarsal joint of great toe. Dissect flap back and expose the tarso-metatarsal joint line.

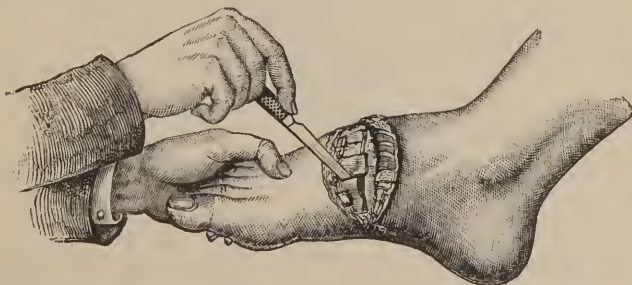
Plantar flap. The incision follows the plantar edge of the fifth metatarsal bone for a short distance, then crosses obliquely the sole to the neck of the fourth metatarsal bone, thence just behind the heads of the metatarsal bones to that of the great toe, and then along its edge to the extremity of the dorsal incision. Dissect back the flap, expose the hollow behind the heads of the metatarsal bones, divide the tendons, then dissect all the soft parts to the line of the tarso-metatarsal joints (Figs. 98 and 99).

Begin the disarticulation from the dorsum: enter the knife just back of the tubercle of the fifth metatarsal bone and open the three outer joints. Then from the inner side, open the first joint, then the joint between the second metatarsal and middle cuneiform bones.

What is Hey's operation?

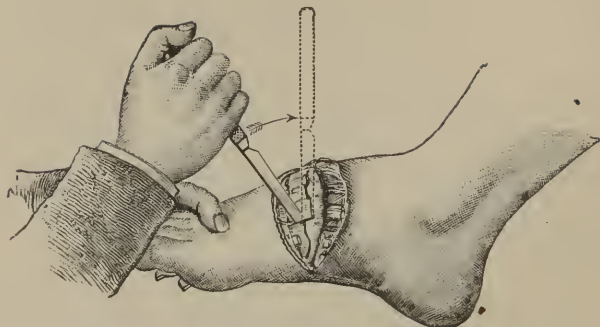
This differs from Lisfranc's in that the internal cuneiform bone is sawn through, instead of being disarticulated from the first metatarsal.

FIG. 98.



The Coup-de-maitre in Lisfranc's Amputation, first step. (Guerin.)

FIG. 99.



The Coup-de-maitre in Lisfranc's Amputation, second step. (Guerin.)

Describe Chopart's amputation.

This is disarticulation of the foot at the mediotarsal joint. For the dorsal flap commence the incision midway between the outer malleolus and the tuberosity of the fifth metatarsal bone; it then follows the outer side of the foot for a short distance, curves over the dorsum, and thence to a point half an inch behind the tuberosity of the scaphoid.

The plantar flap is longer, begins at the same points, and extends

FIG. 100.



Amputation through Medio-tarsal joint. (Bryant.)

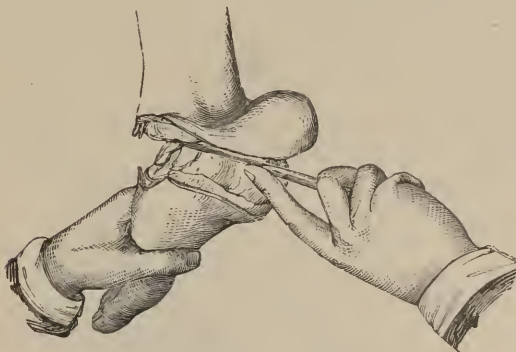
to the middle of the metatarsus. Forcibly depress the anterior part of the foot and disarticulate (Fig. 100).

Describe Syme's amputation.

The flap is made from the heel. After disarticulation the malleoli and articular surface of the tibia are sawn off. Enter the knife just behind the tip of the external malleolus, and cut vertically down and across the sole, and then up vertically to a corresponding point on the inner side of the foot, ending at a point half an inch below the inner malleolus. Carry this incision well down to the bone, and dissect up the heel-flap so as to lay the os calcis perfectly bare.

For the dorsal flap make an incision connecting the extremities of the heel incision and extending across the front of the ankle. Sever the anterior ligaments, enter the knife into the joint, and divide the lateral ligaments from within outward. Complete the disarticulation. Retract the soft parts, and saw off the malleoli and articulating surface of the tibia half an inch above its inferior margin (Fig. 101).

FIG. 101.



Amputation through Ankle-joint, Syme's method. (Skey.)

Describe Pirogoff's operation.

This closely resembles Syme's; it differs in that the os calcis is sawn through, and its hinder part adjusted to the sawn surfaces of the tibia and fibula. Incision nearly the same as Syme's. Commence just in front of the tip of the outer malleolus, and end a little in front of the internal. The heel incision is carried a little

further back than in Syme's operation. The dorsal cut is more convex than in Syme's. Expose the bones and disarticulate. The

FIG. 102.



Diagram of Cutaneous Incision on outer side (*A*), and lines of section of the bones (*B*), in Pirogoff's amputation. (Stimson.)

FIG. 103.



Pirogoff's amputation, lines of incision. (Erichsen.)

upper surface of the os calcis is exposed and sawn off obliquely one finger's breadth behind the astragalus and on a line with the

heel incision. The lower ends of the tibia and fibula are then exposed and sawn off. Arrest hemorrhage, adjust the sawn surfaces of bone in contact, and suture the wound (Figs. 102 and 103).

Describe the amputation at the lower third of the leg by the long posterior flap.

The length of the posterior flap is one-half the circumference of the leg, and reaches down to the insertion of the tendo Achillis, and the anterior flap is one-fourth the length of the posterior. The internal vertical incision is made in front of the tibia, the external just behind the fibula. They meet above the insertion of the tendo Achillis. The posterior flap containing the superficial flexors, is dissected up, the anterior flap then formed, and the bones sawn.

Describe the method of amputating through the middle of the leg.

The posterior flap is equal to the diameter of the limb, and the anterior flap is one-third the length of the posterior.

Describe the method of amputating the thigh through the condyles.

The best method is by antero-posterior flaps. Dissect up a large anterior skin-flap; the lateral incisions commence just below the joint-line; the outer descends along the fibula, and the inner descends two inches just behind the inner edge of the tibia. In length the anterior flap exceeds the diameter of the limb by two inches, and the posterior flap is equal to half the diameter of the limb. The bone is sawn through at the base of the condyles.

Describe the method of amputating the thigh at the middle by a long anterior and short posterior flap.

The flaps are \cap -shaped. The length of the anterior equals one and half times the diameter of the limb at the saw-line, and the posterior equals one-half the diameter.

Describe disarticulation at the hip by the circular method and the use of Wyeth's needles.

Use two long mattress needles. Enter the point of one an inch and a half below and just to the inner side of the anterior superior iliac spine, and cause the needle to pass through the tissues half-way between the great trochanter and the iliac spine external to the neck of the femur, and to emerge behind the trochanter. Pass the second needle an inch below the level of the groin,

and internal to the saphenous opening, through the adductors, and have it emerge an inch and a half in front of the tuber ischii. Protect the points of the needles with corks. Then pass a piece of rubber tubing on the stretch around the thigh and above the needles. Amputate by a circular incision five inches below the tourniquet. In order to facilitate the disarticulation, make a perpendicular incision on the anterior and external aspect of the thigh.

ANÆSTHESIA.

How is local anæsthesia induced?

1. By applying ice and salt to the skin for three minutes;
2. By refrigerating with a spray of ether, rhigolene, benzol, or other vapors;
3. By applying a 4 per cent solution of cocaine hydrochlorate to mucous surfaces or by hypodermatic injections of 5 to 20 minims of the solution into or beneath the skin. The local anæsthetic effect is increased if the solution be incarcerated in the part by retarding the venous return circulation by applying a band or ligature on the proximal side of the circulation.

What agents are usually employed to produce general anæsthesia?

Ether (sulphuric) and chloroform.

How is the patient prepared for the administration of an anæsthetic?

He should take no solid food for at least twelve hours previous to the administration. In the case of a feeble or exhausted patient a little clear soup may be given three hours before, and an ounce of whisky one hour previous to the anæsthetization.

Artificial teeth and other foreign substances should be removed from the mouth, and the patient placed in the recumbent position. Clothing around the chest and waist should be loosened or removed so as not to impede respiration. A hypodermatic injection of morphine ($\frac{1}{6}$ – $\frac{1}{4}$ gr.) and atropine ($\frac{1}{120}$ gr.) often makes the anæsthesia easier and more rapid. Various forms of inhaling apparatus are employed, but a cone made from paper and a folded towel makes a very cleanly and satisfactory apparatus.

What is the method of administering ether?

The patient should be instructed to breathe deeply and regularly. A few drachms of ether are sprinkled on the inhaler, which at first is held at two inches' distance from the face and gradually brought nearer as the air-passages become accustomed to the ether vapor and the respiratory spasm passes off. A full amount of the ether is then poured into the cone, which should now closely cover the nose and mouth of the patient. During the entire period of ether administration the respiration, color of the skin, and the pulse should be closely watched. Respiratory spasm and cyanosis of the skin call for the withdrawal of the ether. Retching and vomiting are arrested by pushing the ether.

When the conjunctiva is insensible to the touch and muscular relaxation occurs, the time for operation has arrived. The ether should then be administered only in quantity sufficient to keep up the anæsthetic state, without inducing continued stertorous breathing.

If heart-failure occur, it is combated by inversion of the patient's body, artificial respiration, and the administration of amyl nitrite and ammonia by inhalation, or nitro-glycerin, digitalis, and atropine hypodermatically.

Persons addicted to the use of alcoholic stimulants require a larger amount of ether to induce profound anæsthesia.

What is the method of inducing anæsthesia with chloroform?

In the administration of chloroform a free admixture of air is necessary. Three or four drops of chloroform should at first be inhaled, and in a few seconds five to ten drops more: when the odor of the chloroform passes off, five to ten drops more should be added, and so on; when signs of deep anæsthesia commence, it is a good plan to discontinue the administration for a moment or two. The pulse and respiration should be carefully watched throughout. The pupils are moderately contracted when surgical anæsthesia is satisfactorily induced.

PLASTIC SURGERY.**What is the object of plastic surgery?**

1. To remedy congenital defects and deformities, such as hare-lip, cleft palate, and exstrophy of the bladder;

2. To remedy defects and deformities caused by ulceration, injury, and cicatricial contraction;

3. To restore the normal appearance of organs that have been rendered unsightly by hypertrophy and abnormal growth.

The term "plasty" is appended to the name of the organ restored, as "rhinoplasty," the restoration of the nose.

What general principles must be observed to secure success in plastic surgery?

1. The patient must be in good health.

2. Sound tissue, especially skin and the subcutaneous cellular tissue, usually taken from the patient's own body, must be cut so as not to interfere with its vascular supply. The flap must be *one-sixth larger* than the space to be filled; it must be handled carefully, and adjusted and sutured precisely.

3. The margins of skin surfaces which are to be brought together must be broadly and evenly freshened.

4. The strictest antiseptic precautions must be observed.

Describe the principal methods used in plastic surgery.

I. *Direct approximation* of freshened edges, all tension upon the parts having been relieved. Used for closing sinuses, fissures, hare-lip, etc.

Freshen the edges by removing a strip of skin and subcutaneous tissue; cleanse; arrest hemorrhage; approximate with fine silk sutures. Relieve tension by undercutting the edges of the wound for a short distance or by parallel incisions on either side.

II. By *sliding* or lateral displacement of the skin and subcutaneous tissue in order to cover a gap. In this method the raw surface to be covered is freshened and a portion of skin and subcutaneous tissue in the immediate neighborhood is dissected up and applied. The edges are sutured so that no tension will fall on the sutures. Surfaces of a triangular, quadrilateral, or elliptical shape may thus be covered by appropriate incisions.

III. *By Flap Formation.*

In this method material is taken from adjacent regions in the shape of a flap with a pedicle, and brought into position by rotating, twisting, everting, etc.

IV. *Transplanting without a Pedicle.*

In this method portions of tissue are taken bodily from their

original places and accurately sutured in their new positions; or small portions of tissue are grafted on a denuded surface.

V. Removal of Redundant Material.

In this method a triangular or elliptical portion of tissue is removed and the remaining edges directly united.

DISEASES AND INJURIES OF THE BRAIN.

What is cerebral concussion?

It is a condition of the brain produced by a blow or physical shock, direct or transmitted, upon the head. It is always doubtful in any given case what this condition really is. Probably in all cases there are more or less minute lacerations of the brain-substance, together with corresponding hemorrhages and a state of general cerebral anæmia. *Clinically*, however, there are a number of symptoms which are fairly constant and characteristic, and a patient with these symptoms and a diagnosis of a recent blow or fall on the head is said to have "cerebral concussion."

What are the symptoms of cerebral concussion?

More or less complete unconsciousness, from which it is possible at times temporarily to arouse the patient; *uniform contraction or dilatation of the pupils*, which, however, usually react to light; *paleness or cyanosis of the skin*; *cold sweat*; *feeble heart-action*; *shallow respiration*; sometimes *incontinence of urine and feces*; *no paralysis*. These symptoms are typical of a severe true concussion. If the unconsciousness is absolute, if the pupils fail to react to light, and if there is paralysis of any sort, then the injury is probably a more or less extensive *true laceration* of the brain, and death will rapidly follow. On the other hand, paleness, giddiness, loss of balance, nausea, and vomiting indicate a very slight degree of concussion, from which recovery is sure and speedy.

What is the course of cerebral concussion?

That of the very severe and light varieties has just been given above. That of the typical variety is as follows: 1. The symptoms, which come on at once after receipt of the injury, persist for over twenty-four hours; there is no reaction, and death ensues. This is comparatively rare.

More commonly, 2. Within twenty-four hours there is *reaction*, usually ushered in by vomiting. This reaction means that the skin becomes warm, the heart-action and respiration improve, consciousness is more or less regained, and the pupils become normal. After this stage of *reaction* one of two things may happen: (a) complete recovery; (b) after twenty-four or forty-eight hours more the symptoms of *general cerebral compression* develop, the outcome of which depends on the cause of the compression.

What is cerebral compression?

This means *pressure on the brain*. There are two kinds: *general cerebral compression* and *local cerebral compression*. The former means pressure distributed generally over the brain; the latter means pressure on some particular part or region of the brain. Either of these varieties may occur alone, and thus give rise to its own symptoms, or they may occur together and present their combined symptoms.

What are the symptoms of local cerebral compression?

As is now well known, in various parts or regions of the brain are situated what are called *centres*. These centres preside each over the function of its own organ or set of organs. Thus we have centres of *motion* for the various groups of, or for even individual, muscles; of *sensation*; of each of the *special senses*, etc. *Destruction* of any one of these centres causes abolition of the function of the corresponding organ, while *compression* of the same causes an irritation of, or what may be called an *excessive action* of the function of, the part which it governs. If severe enough, compression may also cause *abolition* of function. Taking the muscles to illustrate: *Destruction* of a motor centre by laceration of brain-tissue, inflammation, or other cause produces *paralysis* of the corresponding group of muscles. *Compression* of a motor centre causes *convulsions* or *spasms* of these muscles; or, if severe enough, a corresponding *paralysis* may result. Hence *paralysis* or *convulsions* of certain groups of muscles indicate compression on their corresponding centres, and thus constitute the symptoms of one of the varieties of local cerebral compression. Paralysis from compression may be recovered from; that from destruction, never. Other things being equal, however, the treatment is the same for both, as we are not able clinically to judge whether a paralysis is due to destruction or excessive compression.

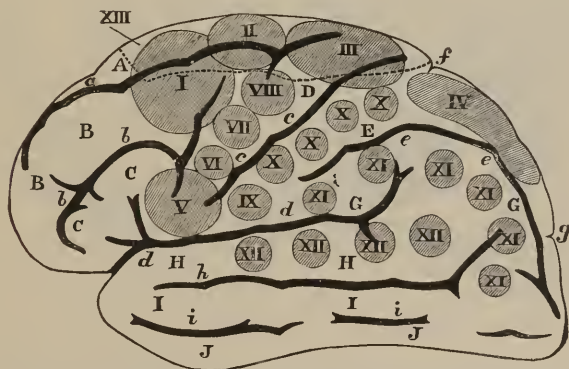
These considerations apply equally to the centres of the various other functions of the body.

What is the significance of these symptoms of local cerebral compression ?

As already said, they indicate *what* centres are involved. Now, we know, by post-mortem observations and experiments on animals, the *actual location* of most of these centres, especially the motor ones. It is therefore always possible to open the skull over any given centre, and actually see and remove, if possible, the cause of the compression or to determine the extent of the destruction.

Various systems of measuring the skull, and thus finding these centres, have been devised, all of which are probably of equal value. One of the more simple will be given below.

FIG. 104.



I. In bases of first and second frontal convolutions chiefly in front of precentral sulcus, for lateral movements of head and eyes, elevation of eyelids, dilatation of pupils. II. At base of first frontal, for extension of arm and hand. III. Occupying upper ends of ascending frontal and parietal convolutions, for complex movements of arms and legs, as in climbing, swimming, etc. IV. In parietal lobule, for movements of leg and foot, as in walking. V. At lower end of ascending frontal, encroaching on ascending parietal and third frontal, for movements of lips (lower facial) and tongue (hypoglossal), as in speaking. VI. and VII. Depression and elevation of angle of mouth. VIII. Supination of hand and flexion of forearm; the last three occupy the middle part of the ascending frontal. IX. At lower end of the ascending parietal, for platysma; retraction of angle of mouth. X. Occupies rest of ascending parietal, for movements of hand and wrist. XI. and XII. indicate sites supposed to be occupied by centres of vision and hearing. XIII. The dotted line has been added to mark out the area, upon the inner surface of the hemisphere, occupied by Horsley and Schafer's centres for the trunk and other muscles. C., at the base of the third frontal, marks the speech-centre.

Where are the motor centres situated?

These are found on both sides of, and above and below, the *fissure of Rolando*. Furthermore, they govern the muscles of the *opposite side of the body*. Hence paralysis or spasm of one or more groups of muscles on the *right* side of the body indicates cerebral

FIG. 105.

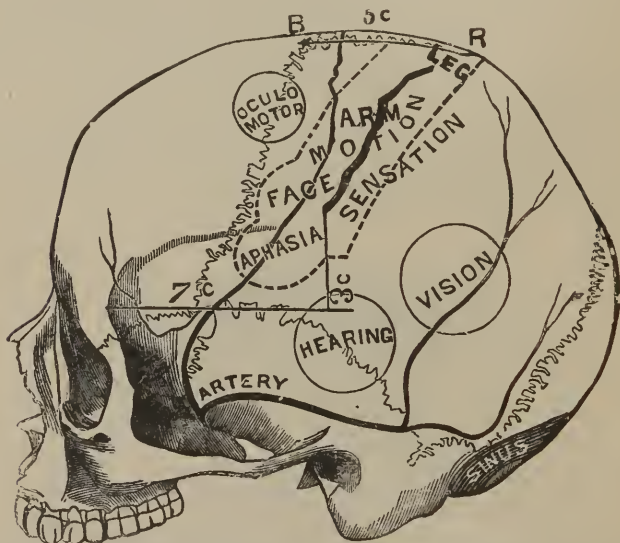


Diagram of Skull, showing lines of fissure of Rolando, middle meningeal artery, and cortical centres.

compression on the corresponding centres of the *left* side of the brain. The number or extent of the muscles involved simply indicates a greater or less area of compression or number of centres compressed. But there is a limit to this idea. Thus, *bilateral* general convulsions or general paralysis do not necessarily mean that there is a clearly-defined compression on both sides and along the entire length of *both* fissures of Rolando. Such convulsions or paralysis *might be* the result of such a condition, but, being due to so many other causes as well, their presence is by no means an indication in themselves for operation.

FIG. 106.

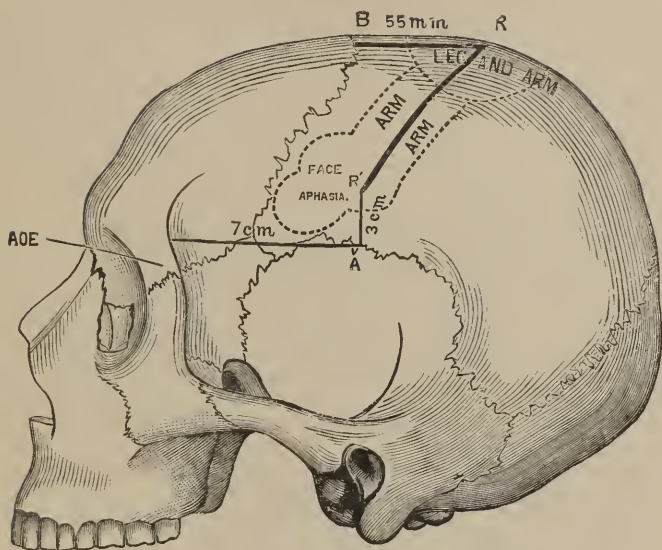


Diagram showing one method of locating the Fissure of Rolando (Nancrede).

(For location of particular motor and other centres see Fig. 104; also Figs. 105 and 106).

Give a method for determining on the skull the position of the fissure of Rolando.

The *upper end* of the fissure is between $6\frac{1}{2}$ and $7\frac{1}{2}$ inches from the root of the nose, measured on a line taken straight back to the external occipital protuberance.

The *lower end*.—Pass a tape circumferentially about the head on a level with the root of the nose, and *bisect* this, at right angles, with another tape passing *transversely* across the head. Then *from* the point at which this last tape intersects the antero-posterior median line of the head measure down *on* this tape between 4 and $4\frac{3}{8}$ inches. Just a little anterior to this point is the *lower end* of the fissure of Rolando (Fraser).

What are the symptoms of general cerebral compression?

Coming on, as a rule, within forty-eight hours after receipt of the injury and following cerebral concussion, they are—*complete unconsciousness*, from which the patient cannot be aroused; *pupils unequally contracted or dilated*; *skin warm*; *face flushed*; *temperature 99°–100°*; *heart-action slow and strong*; *respiration slow, full, and stertorous*; at times *general convulsions*. A milder form sometimes occurs, in which the unconsciousness is not complete and irritability is marked.

What is the course of general cerebral compression?

The mild cases commonly end in recovery at the end of a week or so. The severer cases may last for weeks and then recover, but the prognosis is unfavorable. The symptoms as given above are those most commonly seen, and the cause is either *hemorrhage* or *depressed fracture of the skull* (traumatic); more rarely *cerebral tumor*. Should *inflammation* ensue or occur primarily, then certain other symptoms are superadded or are present from the beginning, as the case may be.

What are the causes of cerebral compression?

They are *hemorrhage*, *depressed fractures of the skull*, *the products of inflammation*, and *cerebral tumors*.

Discuss the cause of hemorrhage.

Hemorrhage which causes cerebral compression is in general known as *intracranial*, and may be situated (*a*) between the skull and the dura mater, *extradural hemorrhage*; (*b*) between the dura and the brain (including arachnoid and pia or not—no distinction clinically), *subdural hemorrhage*; (*c*) within the brain itself, *intracerebral hemorrhage*. The first is invariably due to traumatism; the second almost always so, but in some cases the vessel-walls may be the seat of pathological changes; while the third variety is caused equally either by traumatism or pathological changes in the walls of the blood-vessels. Intracerebral hemorrhage due to pathological changes in the walls of the blood-vessels is known as *apoplexy*, of which the symptoms are simply those of general cerebral compression. Of these varieties, furthermore, the first commonly causes general cerebral compression, or at times "local" compression may also be present in the form of either *unilateral general convulsions* or *hemiplegia*. (The last two named conditions, by the

way, barring out all other causes, represent the extreme degree, as regards the motor apparatus, of *local cerebral compression*.) The same may be said of subdural hemorrhage, except, in addition, that it has more of a tendency to produce the *more limited* forms of compression of the motor centres. The *third* variety induces general or local compression according to its extent and location, or it may cause both.

What may be said as to the diagnosis of cerebral compression?

The actual condition of cerebral compression, general or local, is, as a rule, sufficiently clear. The question always is as to the *causation*. And in very many cases this often remains a matter of doubt. This whole question, including treatment, may perhaps be better appreciated by reference to the following table. It is understood, of course, that necessarily only typical cases are therein presented. Complicated cases or those in which more than one cause is operating to produce compression symptoms are not considered. Such cases must be diagnosed by a regard to the combined symptoms of single causes.

What are the general principles of the non-operative treatment of general cerebral compression?

Rest. A purge given at once, consisting of extract of jalap and calomel, gr. vj-vij each. In a day or two calomel, gr. $\frac{1}{4}$ *t. i. d.*, may be given right along. Fluid diet. Restraint may be necessary if violence occurs; opium, bromides, and the various hypnotics.

Treatment of Cerebral Concussion.—External warmth, elevation of the legs, stimulation by mouth, rectum, or hypodermically.

What are shock and collapse?

These are conditions greatly resembling, if not identical clinically with, cerebral concussion. The same treatment applies.

Shock may have a mental cause, or result from a blow other than on the head.

Collapse is used to describe the condition of a patient resulting from *loss of blood*, from a long-continued acute illness, from acute intestinal obstruction, or from the ingestion of a gastro-intestinal poison. *Saline infusion* is indicated through the *basilic vein* (sodium bicarb. 1 part; sodium chloride 5 parts; water (boiled) 1000 parts) in collapse from hemorrhage. (See also Hemorrhage, under Injuries and Diseases of Circulatory System.)

3. PRODUCTS OF INFLAMMATION.

Abscess of the brain.

(When, due to supplicative encephalitis, the blow or fracture, the site is always in the cent or remote, or to disk, and dilatation of pupil be trephined over the temporo - sphenoidal suppurative otitis media, and in a region dia covered by a circle.) (The *course* may be presson.

1. Symptoms of general compression + headache, toms are sufficiently clear, the skull should be trephined over the region indicated, and the abscess opened and the cavity packed. In the absence of "local" symptoms trephine over the site of the injury as indicated by a scar. If the media, is regular pus-temperated by a scar. If the is peculiar in being after an open the mastoid process, normal or sub-cess or trephine $1\frac{1}{4}$ in. behind and above ext. meatus.

2. Symptoms of local compression.

3. Chill, delirium, temperature, in cases following suppurative otitis media, is regular pus-temperated by a scar. If the is peculiar in being after an open the mastoid process, normal or sub-cess or trephine $1\frac{1}{4}$ in. behind and above ext. meatus.

spoken of: 1 = "pressure" symptoms; 2 = "focal" symptoms; 3 = "suppurative" symptoms.

Encephalitis. (For cicatrix see Epilepsy.)

Diffused inflammation of the brain, serious or suppurative, together with a corresponding meningitis, both lepto- and pachy-

Symptoms of general compression + headache, delirium, high temperature, and, if severe, general convulsions and paralysis.

Quiet. Ice-cap. Regnulation of the bowels and reduction of temperature: opium, bromides, etc. No operation unless local symptoms develop.

"Cerebral tumors" may be any one of the regular tumors or a circumscribed tubercular or syphilitic inflammation. The course is usually slow. According to Seguin and Weir, of cerebral tumors 23 per cent. are tubercular; 13 per cent. are sarcomata; 4 per cent. are ependymomata; 4.6 per cent. are cysts; and 3.6 per cent. are gummata.

General compression symptoms absent, except when tumor becomes very large. Head-size and strong adhesion. General convulsions are contraindications to attempts at removal of local compression symptoms. Hence a most careful examination of the functions of all the centres, speech, motor, sensory, special senses, etc., is most important.

When clearly located, removal by trephining is indicated. Very large size and strong adhesions are contraindications to attempts at removal.

4. CEREBRAL TUMORS.

Cerebral compression, general and local (continued).

What are the general principles of the operative treatment of general cerebral compression?

A patient suffering from general cerebral compression, from whatever cause, should *not* be trephined except when there is a *simultaneous* existence of one of the following conditions:

1. Any mark or sign on the head of external violence, of recent or remote origin, no matter where its site may be. This, of course, includes fractures. Here it is always advisable to trephine over this spot, as the cause *may be* removable, for the reason that even a *limited* hemorrhage, etc. may give rise to general rather than local pressure symptoms.

2. Any signs of *local* pressure—*i. e.* on any given *centre* or *centres*. This includes, of course, hemiplegia or *unilateral* general convulsions.

3. *When a period of consciousness intervenes* between the concussion immediately following the blow and the general compression symptoms, even if there are no marks of external violence. (See also foregoing table.)

Explain the reason for No. 3.

The dura mater is *intimately adherent* to the skull. Therefore it takes some little time for the blood to overcome this adherence, dissect off the dura, and thus to produce compression on the brain. (See also preceding table.)

What is the treatment of local cerebral compression?

Pure *local* cerebral compression means simply the appearance of symptoms indicating pressure on one or more of the *centres*, and *unaccompanied by* any symptoms of general pressure, no unconsciousness, etc.

Treatment.—Trephining over the centre and removal of the cause.

From this point of view even *bilateral* general convulsions may be regarded as symptoms of a *local* pressure, and thus *operative treatment* is indicated, just as in the regular *limited* varieties. Such cases are known as surgical epilepsy, and a *cicatrix* of some former injury is *always* present. If by careful examination it is decided that the cicatrix is the cause of the epilepsy, it should then be removed. The depth of the cicatrix varies; that is, the dura beneath may be normal or the scar may extend to or into the brain-substance. Of course the more limited the convulsions are, the greater is the indication for the removal of the scar.

What is Jacksonian epilepsy?

This term is applied to cases in which there occur spasms of certain limited groups of muscles, but *consciousness is retained* and there is *no history nor sign of traumatism* nor of *any one* of the regular causes of cerebral compression. The operative treatment is trephining over the proper centres and excising the corresponding cortical areas. Practically, however, it is not yet settled whether this is really the best treatment.

Discuss bullet-wounds of the brain.

The existence of a wound of exit shows the bullet has passed out, its absence the contrary; hence the importance of first determining this point. A bullet is hardly large enough *in itself* to cause general cerebral compression. This condition following the entrance into the brain of a bullet is due to the resulting hemorrhage or inflammation. The track made by a bullet should always be probed, and the bullet extracted if possible (this procedure is unnecessary if there is a wound of exit). The point of entrance should be freely exposed by suitable enlargement of the skull-wound. Drainage may be provided for with a rubber tube passed into the track of the bullet. If necessary, *through drainage* may be established by a *counter-opening*, which last may also be indicated as an aid to extraction of the bullet.

Define the nature and causes of traumatic delirium tremens.

This is a nervous affection following the receipt of an injury, characterized by muscular tremor and restless delirium. It occurs in persons whose nervous systems have undergone deterioration from the use of alcohol or narcotics. It is most frequently seen after compound fractures or extensive burns.

What pathological changes may be found?

Meningeal congestion and hemorrhage and effusion of serum into the ventricles; fatty changes in the nerve-tissue, liver, and kidneys.

Describe the symptoms.

Restlessness, insomnia, and muscular tremor. The delirium is more marked at night and is accompanied with constant chattering. There is no desire for food, the bowels are costive, and the urine is scanty and high-colored. The pulse and temperature are but slightly elevated.

Describe the treatment.

The condition is an asthenic one, therefore tonics and concentrated nutriment are required. A dose of calomel or a Seidlitz powder may be given in the beginning. Chloral and bromides, with an occasional dose of morphine, are indicated for the sleeplessness. Digitalis and strychnine are useful. Milk punch is indicated when the condition of the patient is low. Local inflammatory conditions should receive antiseptic treatment to combat septic infection.

Discuss hydrocephalus.

Acute hydrocephalus is tubercular meningitis and tubercular ependymitis combined. The symptoms resemble those of acute encephalitis (see table), except that the temperature is not so high, and *rigidity of the muscles of the neck* is especially marked. There is no operative treatment.

Chronic hydrocephalus is usually congenital or develops soon after birth. The head is abnormally large and the skull-bones are separated, this condition being due to distension of the lateral ventricles with a large amount of serum. *Prognosis* is bad. Tapping the ventricles by means of a fine trocar through the anterior fontanelle has been done successfully, but only in a very few cases.

What is meningocele ?

This is a protrusion of the membranes of the brain, enclosing fluid which is extracerebral, through a congenital opening in the skull. This opening is usually in the median line and in the occipital bone; it may be in the median line of the frontal bone; still more rarely at the sides or the base of the skull.

Treatment.—Incision, removal of redundant membranes, and suture of the edges. This has been fairly successful (Fig. 107).

FIG. 107.



Meningocele.

What is encephalocele ?

This is a similar condition, except that a portion of the brain is also present inside the protruded sac of membranes. Operative treatment is hardly indicated unless the tumor is small, and then it may heal spontaneously. Gentle manipulation and pressure, however, may be tried.

What is hydrencephalocele ?

A condition similar to the preceding, except that the cavity of the tumor communicates with or is an offshoot from the lateral ventricles. Early death is the rule. There is no treatment.

What is fungus cerebri ?

This is protrusion of brain-substance, which may occur at once through the opening made by a large compound comminuted fracture of the skull or after trephining for the same. It may occur later in cases in which the dura has been lacerated, so that it could not be sutured, or in which it has been necessary to pack the wound. In such cases the fungus is a mixture of granulation tissue and brain-substance. It may be treated by simple pressure, or, if large and increasing, its pedicle may be pierced with a double ligature, tied, and the redundancy cut off.

What is craniectomy ?

This is dissection of a longitudinal groove in the skull whose depth equals the entire thickness of the skull. It is generally made on one side of the median line, and may extend from well up on the frontal bone back to and on the occipital. The object is to allow the skull to expand by growth of the brain. The condition for which the operation is indicated is *microcephalus*, or a head prematurely ossified (even at the fontanelles), thus preventing growth of the brain, and causing thereby mental impairment or even idiocy.

DISEASES AND INJURIES OF THE SPINAL CORD AND NERVES.

What is spina bifida ?

Owing to an arrest of development of the spine, usually limited to a failure of the spinal arches to unite, the cord and membrane protrude through the opening, forming a tumor. When the pro-

trusion consists of fluid and membranes only, it is termed *meningocele*; with a portion of the cord also it is *meningo-myelocle*; when the central canal of the cord is dilated it is called *syringo-myelocle*.

Describe the treatment.

Support by a cotton dressing and an elastic bandage. Excision of the sac in meningocele has been practised in some cases. Injection of the sac with iodine may also be tried.

What is usually understood by the term "spinal concussion"?

The *symptoms* are those which usually attend a mild degree of shock. The progressive spinal symptoms which have been described as occurring after concussion have probably been the result of spinal contusion or laceration.

What is spinal compression?

Pressure on the spinal cord. The *causes* are of the same nature as those of *cerebral compression*.

The *diagnosis in general* of spinal compression is based on symptoms indicative of disturbances to the functions of the *motor* and *sensory* nerves and the *bladder*. *Spasms* and *paralysis* show involvement of the motor nerves; *hyperæsthesia* and *anæsthesia*, of the sensory nerves. The *extent* of the compression is shown, *longitudinally*, by the number of muscles irritated or paralyzed and by the limits of the areas of hyper- or anæsthesia; *transversely*, by whether these indications are *uni-* or *bilateral*.

Differential diagnosis as to causation often requires a most minute and detailed examination of the case. The following table shows the more important points:

Fracture or dislocation.	{ Symptoms are immediate.
	{ Careful palpation should determine site, etc.
Tumors.	{ Slow and gradual onset of symptoms.
Hemorrhage	{ Symptoms appear after some hours.
Products of "spinal inflammation" (meningitis or myelitis).	{ Symptoms appear after some days + septicæmia.

Furthermore, *intramedullary* hemorrhage, tumors, or inflammation

(myelitis) is more apt to cause *paralysis*, while *extramedullary* hemorrhage, tumors, or inflammation (meningitis) is more liable to produce *spasms*.

By what means other than fractures are wounds of the spinal cord usually produced?

Bullets or pointed instruments. The *local treatment* of such injuries consists in removing the fragments of bone or the foreign bodies; the same for *compound* fractures.

Mention some of the symptoms of "spinal inflammation."

Pain, increased by motion or pressure; burning or tingling sensations; hyperæsthesia or anæsthesia; feeling of constriction around the body; muscular spasms and contractions; motor paralysis in myelitis. Paralysis indicates disorganization of the nerve-fibres. Bed-sores and atrophic changes follow the paralysis. The bladder becomes paralyzed, and retention of urine occurs. The urine becomes alkaline, and cystitis results. Priapism occurs in many cases. Incontinence of fæces occurs when the injury is in the lower part of the cord. Paralysis of the bowel and constipation exist when the injury is higher up. Dyspnœa results when the paralysis is located in the intercostal and serrated muscles. Injury above the origin of the phrenic nerve causes instant death.

Describe the treatment of intraspinal inflammation.

Rest in the prone position; wet cups, leeches, and the ice-bag applied to the spine; internally, iodide of potassium, mercury, belladonna, and ergot; morphine and bromide to relieve pain. In *chronic* cases with paralysis, subcutaneous use of strychnine is recommended. With retention of urine pass the catheter three times per day. Wash out the bladder for cystitis. Prevent bed-sores by cleanliness, bathing with alcohol, and the use of a water-bed.

OF THE NERVES.

Mention the causes and varieties of neuritis.

Exposure to cold, wounds, strains, rheumatism, gout, and syphilis. The varieties are specific and non-specific, each of which may be acute or chronic. The pathological changes peculiar to each occur in the neurilemma. Granular and fatty degeneration, ending in softening and atrophy, occur in the fibres.

Describe the symptoms.

In the motor nerves, increased irritability, spasm, and twitching of the muscles. In the sensory nerves, pain and hyperæsthesia, followed by analgesia and anæsthesia. In mixed nerves these symptoms are associated. Fever and constitutional symptoms vary with the intensity of the neuritis.

Describe the treatment.

For the *chronic* forms use counter-irritation by blisters, galvanism, and the actual cautery; internally the iodide of potassium. Hypodermatic injections of chloroform, cocaine, and osmic acid are sometimes useful. Nerve-stretching or resection may become necessary. The *acute* forms of neuritis, if non-specific, need the usual surgical treatment of wet dressings, or incision if suppurative.

Mention the various forms of injuries that may occur to nerves.

Contusions and wounds. Of the latter, incised or lacerated wounds may sever the nerve completely or partially.

Describe the symptoms accompanying nerve-injuries.

Pain at the seat of injury, tingling and numbness along the distribution, spasms, or paralysis. Subsequent to the injury neuritis may develop. Compression from the cicatrix may cause atrophic changes. If a nerve is divided, the ends retract and become bulbous, and *rarely* are finally united by the development of new nerve-tissue. During the period of repair neighboring nerves may assume some of the functions of those injured.

What is the treatment?

In an open wound the divided ends should be immediately sutured. In a subcutaneous injury an incision should be made, the nerve found, and its ends sutured.

DISEASES OF GLANDS.

DISEASES OF THE FEMALE BREAST.

What is mastitis or mammitis?

This is inflammation of the breast, and its varieties are those of inflammation in general. *Suppurative mastitis*, or abscess of the breast, is the most common, and occurs mainly during lactation. The pus may be superficial (supramammary), or in the tissues

between the acini (intramammary), or behind the gland (retromammary).

The *symptoms* are those of acute abscess anywhere.

Treatment is by incision and drainage. Supramammary abscesses should be incised in a line or lines radiating from the nipple. It will often be necessary to use the breast-pump frequently during the after-treatment, and nursing with the breast affected should not be allowed.

Discuss the benign tumors of the breast.

Of the benign tumors, pure fibromata and adenomata are excessively rare. The usual occurrence is a combination of the two growths as *fibro-adenomata*. What was formerly regarded as a diffuse fibroma occupying the entire gland is now more properly considered to be a non-specific chronic productive mastitis. The ordinary fibro-adenoma is of slow growth, circumscribed, hard, freely movable, with the superjacent tissues also freely movable, usually not painful or tender, without involvement of the axillary lymphatic glands, and, generally speaking, occurs in women past thirty who have not borne children. General health unimpaired. Incision and enucleation without opening the axilla is the treatment.

Discuss the malignant tumors of the breast.

These are sarcomata and carcinomata.

Carcinoma may be scirrhus or cnecephaloid. A table of the varieties of carcinoma is given on the next page. Perhaps the most common is the more or less circumscribed form. This is a very hard mass of rapid growth, adherent both to the underlying and overlying tissues, including the skin; painful, and often with radiating pains down the axilla and arm, with involvement of the axillary glands, and, generally speaking, occurs in women over thirty-five and who have had children. General health greatly affected.

Sarcomata.—A sarcoma presents, practically, all of the above symptoms, except that it is quite distinctly circumscribed, *may* not (it does quite often) involve the axillary glands, and, generally speaking, occurs in young (under thirty-five) women who have had no children. General health may not be affected, but usually is.

What is the differential diagnosis of tumors of the breast?

From the preceding it will be seen that a difference between a fibro-adenoma on the one hand and a sarcoma and carcinoma on the other is comparatively easy. But, as between sarcoma and the

form of carcinoma described, the difference depends only on the age and condition of the patient and the involvement or otherwise of the axillary glands. But as these points are not absolute, it very often happens that no differential diagnosis can be made. As the treatment is the same for both, this diagnosis is not so important.

What is the treatment of malignant tumors of the breast?

Removal of the tumor, together with the entire breast and axillary glands. The incision is usually oval, and extends obliquely from the axilla downward and forward and surrounds the breast, which, together with all the fatty tissue down to the pectoralis major muscle, should be removed. The axilla is now opened by an incision prolonged from the upper end of the first, and its entire lymphatic and fatty contents taken out. The wound is closed. Should separation of the edges be too great at any point to admit of their approximation, the exposed surface thus left may be packed with iodoform gauze and allowed to granulate, or it may be grafted at once after Thiersch's method.

Carcinoma of the breast.	{	Scirrhus.	{	1. A more or less circumscribed mass; already described.
				2. Involves the entire breast, which shrinks and atrophies and is very hard; surrounding tissues infiltrated.
				3. Occurs as small hard nodules scattered through the breast (rather rare).
	{	Encephaloid.	{	1. Occurs as a large mass practically involving the entire breast, which is rather soft, and with the skin somewhat bluish and infiltrated. Very rapid and fatal.
				2. As a more or less circumscribed mass (rare).
				3. As nodules (very rare).
Epithelioma of the breast.			{	"Paget's disease of the nipple."
			{	"Eczematous" at first, then rapid ulceration and extension.

What are cysts of the breast?

They are usually regular *retention-cysts*, and give the same local symptoms as fibro-adenomata. Their contents may give fluctuation, and are serous or lactaceous. Or a solid tumor may undergo cystic degeneration—i. e. cysto-adenoma, cysto-sarcoma, and cysto-carcinoma. The latter is often spoken of as colloid carcinoma.

DISEASES OF THE THYROID GLAND.**Explain the use of the terms goitre and struma.**

Enlargements of the thyroid gland, other than those due to inflammation, are called in general *goitre*. Goitre is divided into two main classes: (a) *with* constitutional symptoms; (b) occurring *without* constitutional symptoms.

Class (a) includes *exophthalmic goitre* and *cretinism*; Class (b) includes a number of varieties, of which the generic name is *struma*.

What is struma?

Struma is enlargement of the thyroid gland unaccompanied by any symptoms save those due to the enlargement, pressure symptoms, etc. It occurs usually after thirty years and in either sex, and with a previous history of good health or otherwise. (For the different varieties of struma see the following table, which is easy of remembrance if one bears in mind the normal structure of the gland—viz. *vesicles* lined with *epithelium*, and *fibrous tissue*.)

What is understood by cretinism?

This is described in many books as being both *endemic* and *sporadic*. As *sporadic* cretinism has been fairly well determined to be *myxœdema* (which see), it would be better to confine the word *cretinism* entirely to the so-called *endemic* variety. This is the well-known disease common in certain mountain districts, and characterized by an enormous hypertrophy of the thyroid gland, together with certain deformities of the trunk and limbs, more or less idiocy, deafness, dumbness, etc.

What is post-operative myxœdema?

This is a condition resembling true myxœdema, but is even more rapid and fatal. Its *only* occurrence is *after entire removal* of the thyroid gland. Hence, although it may not occur, a portion of the gland may be left behind as a precautionary measure in removing a struma. *Cachexia strumipriva* is a synonym.

VARIETIES OF STRUMA.

		PATHOLOGY.	TREATMENT, ETC.
1. STRUMA HYPERTROPHICA, or simple hypertrophy.	<p>A progressive enlargement of the gland due to an increase in amount of the <i>fibrous tissue</i> and an increase both in number and size of the <i>vesicles</i>.</p> <p>Small <i>nodes</i> or masses are scattered throughout the gland. These nodes may be made up of—</p> <p>(a) Groups of <i>epithelial cells</i> having no basement membrane. They greatly resemble carcinoma;</p> <p>(b) Groups of <i>original vesicles</i>, simply enlarged and containing colloid material;</p> <p>(c) Small masses of <i>fibrous tissue</i>; may become calcified;</p> <p>(d) Enlarged <i>veins, capillaries, or arteries</i>.</p>	<p>This is the most common variety. Extirpation is indicated unless of small size and causing no trouble.</p> <p>Enucleation or extirpation if signs of malignancy—<i>i. e.</i> metastasis, cachexia, etc.—are present.</p> <p>Enucleation.</p> <p>Ligature and subsequent enucleation.</p> <p>Tapping and injection of iodine.</p>
2. STRUMA NODOSA.	<p><i>Adenomatosa.</i></p> <p><i>Follicularis, or colloid hypertrophy.</i></p> <p><i>Fibrosa.</i></p> <p><i>Vascularis.</i></p>	<p>The gland is entirely taken up with a cystic tumor (serous or gelatinous) as the result of an enlargement of <i>one vesicle</i> or of the coalescence of <i>several enlarged vesicles</i>.</p>	<p>Rare. Extirpation when possible. Its more common occurrence is as the <i>local</i> lesion in myxedema.</p>
3. STRUMA GELATINOSA, or cystic goitre.		
4. STRUMA HYPERPLASTICA, or fibrous goitre.	<p>The gland is gradually destroyed by a diffuse growth of fibrous tissue, with or without actual enlargement.</p>	

DISEASES OF THE TONGUE, MOUTH, AND LIPS.

What is glossitis?

This is inflammation of the tongue. Of its varieties, the non-specific are comparatively rare, and should be treated as are similar inflammations elsewhere—suppuration incised, etc. Of the *specific* varieties, tubercular and syphilitic glossitis are important. As a rule, these inflammations are *circumscribed*, rather than diffused throughout the tongue, and those which are tubercular are usually superficial; syphilitic inflammation when deep-seated really constitutes a *gumma*. Both varieties sooner or later form *ulcers*.

What other causes are there for ulcers of the tongue?

Epithelioma, chancre, the “secondary” lesions of syphilis, and traumatism. The last two will not be further considered. (For an approximate differential diagnosis between *ulcers of the tongue* due respectively to tubercular and syphilitic glossitis, epithelioma, and chancre, see following table.)

What is ranula?

It is a cyst occurring in the floor of the mouth. It may be due to dilatation of one of the mucous glands or of the lingual gland, or more rarely of *Fleischman's duct*. This is obliterated, as a rule, but may persist. It is a foetal remnant, and extends from the foramen cæcum of the tongue to the thyroid gland.

What affections of the lips are of surgical importance?

Ulcers and hare-lip.

Describe the ulcers.

They are practically the same as occur in the tongue, except that *epithelioma* is much more frequent than the other varieties. A diagnosis between these ulcers may be made, based on the same points already given for similar ulcers of the tongue. Epithelioma should be removed by a V-shaped incision.

What is hare-lip?

It is a defect in the upper lip. It may be single or double. It consists of a *cleft* or *fissure* of a depth varying from a mere indentation up to a *complete* severance of the lip. It is always in a line corresponding to that separating the lateral incisor from the canine tooth. It is congenital, and is due to a failure to unite on the part

ULCERS OF THE TONGUE.

<i>Edges.</i>	<i>Palpation.</i>	<i>Site.</i>	<i>Number.</i>	<i>Begins as—</i>	<i>Pain and tenderness.</i>	<i>Submar. l. glands.</i>	<i>See and age.</i>	<i>Previous history.</i>	<i>Rate of growth.</i>	<i>Microscope.</i>
Raised, nodular, hard.	Wide induration.	Borders of anterior half.	Single.	1. Warty growth; 2. Nodule in tongue-substance (rare). 3. A fissure, abrasion, vesicle, papule, etc.	Pain, radiating and increasing. 3. Tenderness, not so marked.	Always enlarged; usually within three months.	Men more commonly. 40-60 years. If on lip, 20-30 years.	Mechanical injury, irritation, etc.	If left alone, death from exhaustion or hemorrhage in 12-18 months. If on lip, slow. et.	Epithelial cells "atypical" found in scrapings.
Undermined.	Induration limited to size of ulcer.	1. Central parts of dorsum, of half. 2. Floor of mouth near frænum.	May be single; are often multiple, and + fissures.	A lump in tongue-substance.	Rather more tender than painful.	Rarely if ever enlarged.	Men more commonly. 40-50 years. Con-genital (rare).	Syphilitic.	Slow and progressive, but tends to heal under treatment.	
Bevelled. May be mil-lary tuber-cles on ad-jacent mu-cous mem-brane.	No in-dura-tion.	1. At or near tip. 2. Any part of dorsum.	Usually single; may be multiple.	1. A vesicle. 2. Tiny nodule. 3. Like epithelioma.	At first neither; later both.	No rule: affected late or early, or not at all.	Men; any age.	Secondary to tubercu-losis else-where. May be primary.	Varies. May be like epithe-lioma. If slow, bands of cicatrized tissue appear and break down again.	Bacillus of "tuber-cle-tissue" cells.
Hard.	Cir-cum-scribed indura-tion.	At or near tip.	Single.	Papule.	Neither	Early involvement, but not permanent.	Any age; either sex.	Direct infection.	Subsides at or before appearance of "secondaries."	

Epithelioma.

Gumma.

Tubercular.

Chancre.

of the foetal folds from which respectively are to be developed the *central* and *lateral* portions of the upper lip. It may occur without cleft palate.

What is the treatment?

A plastic operation of freshening the edges and bringing them together by sutures, or by either of the methods represented by Figs. 108 and 109. The latter is to be preferred in cases where there is a bridge of tissue at the upper part of the cleft.

FIG. 108.



Operation for Single Hare-lip.

FIG. 109.



Nélaton's Operation.

Hare-lip may be operated upon within a few weeks after birth, but, as a rule, it is best to wait for six months. It all depends on the physical condition of the child and its ability to take nourishment.

What is cleft palate?

This is a condition of the hard palate which corresponds exactly to "hare-lip" in the lip, and is of similar origin.

The foetal folds from which are developed each half of the upper jaw do not unite with one another in the middle line anteriorly, but with a *middle* fold coming down from the nose, and from which the so-called "intermaxillary bone" (containing the four incisor teeth) is formed. Hence cleft palate is never in the median line *anteriorly*, but occupies a position exactly on a line with that of hare-lip. *Posteriorly*, or behind the alveolar margin, the cleft is in the middle line. Cleft palate may be single or double, and in either case may coexist with a hare-lip. It may or may not involve the soft palate as well.

What is the treatment?

Freshen the edges of the cleft. The approximation is effected by bending down the bone on each side and by suturing the mucous membrane. These procedures are facilitated as follows: Make a

longitudinal incision through the mucous membrane to the bone on each side of the cleft, midway between it and the alveolar margin. Then loosen the mucous membrane on each side between the incision and the cleft. This aids the suturing. A series of small holes are now drilled through the bone along the line of each incision. This helps the bending down of the bone. The operation, as a rule, ought not to be performed until the fifth or sixth year.

How may the tongue be removed?

Removal of the tongue is indicated for epithelioma and advanced tuberculosis. There are various methods, of which probably the most practical is *Whitehead's*, as follows: Insert a mouth-gag, and then deliberately cut out the entire tongue with scissors, beginning at the frænum and keeping close to the floor of the mouth. The lingual arteries may be clamped first at the base of the anterior pillars of the fauces, or not until they are cut. The hemorrhage is easily controlled.

What may be said as to malignant tumors of the jaw?

Upper Jaw.—Carcinoma seems to be the most common of the malignant growths. It starts in one of the mucous glands of the mucous membrane lining the nasal cavity or that of the antrum of Highmore. Diagnosis is made by observing the condition of the eye and of the nasal fossa on the side affected, and by palpating the mouth and pharynx.

Treatment.—Removal of the upper jaw.

Lower Jaw.—Sarcoma of the lower jaw is either *subperiosteal* or *central*. The latter is of quicker growth, and on palpation gives a crackling feeling. The former is slow in growth, quite hard to the touch, and in developing seems to embrace the angle and ramus. This condition is ascertained by palpating the jaw both from without and within.

What is salivary fistula?

It is an opening into Stenson's duct, either externally or from within the mouth. It is due to traumatism or to obstruction of the duct from calculus or inflammation. A plastic operation is necessary for restoration.

What is epulis?

This means, literally, "on the gum." Hence it is applied to a tumor on the gum. Epulis is either a fibroma or a sarcoma or a fibro-sarcoma.

INJURIES OF THE LARYNX.

Mention the varieties of injuries of the larynx.

The larynx may be injured from without or from within. If the former, contusions and incised wounds are most common. Internal wounds are produced by foreign bodies, such as fish-hooks, needles, pieces of bone, glass, etc.

Describe the treatment for injuries of the larynx.

In an incised wound, if seen early, approximate and suture all the divided tissues. In some cases a low preliminary tracheotomy may be indicated. It may be necessary for a few days to feed by the rectum. For internal injuries from foreign bodies, if the symptoms are urgent, perform immediate tracheotomy; then if possible locate and remove the foreign body.

What symptoms are produced by fracture of the larynx?

Sometimes unconsciousness, followed by rapid œdema and death. Pain, dyspnœa, cough, dysphonia or aphonia, dysphagia, with ejection of frothy mucus and blood, are the usual symptoms; cellular emphysema of the neck may occur.

What is the treatment for fracture of the larynx?

1. Immediate tracheotomy;
2. Replace broken cartilages and retain in place by external support or by suture.

In what way do foreign bodies gain entrance to the larynx and trachea?

Normally, contact of a foreign body with the margins of the glottis causes its instant closure, but with a *violent* or sudden inspiration various substances may be sucked into the air-passages.

What symptoms are induced?

Spasmodic cough, spasm of the glottis, feeling of suffocation. Death may occur suddenly, but is usually preceded by lividity of countenance, gasping for breath, etc.

Urgent symptoms may subside, to be followed by pain, periods of coughing, expectoration of blood and mucus. The foreign body may be coughed up against the under aspect of the glottis and cause again suffocating asphyxia.

If one bronchus is stopped, there will be absence of the respiratory sound on that side. Secondary bronchitis may ensue.

The *diagnosis* is made by the history, the auscultatory sounds, and laryngoscopic examination.

What is the method of treatment?

Immediate tracheotomy. Suspension of the body, head down, may be tried after the trachea is opened. Remove impacted substance from the larynx with forceps and the laryngoscope or by opening the larynx: the thyroid cartilage may be incised in the median line (thyrotomy). If the body is impacted in the trachea or bronchus, tracheotomy should be done and an attempt made to reach it with forceps.

What are the indications for tracheotomy?

Obstruction of the larynx from membranous inflammation (croup or diphtheria), tubercular or syphilitic laryngitis, foreign bodies or tumors, and cicatricial contraction.

It should be done in all cases before the patient becomes too exhausted to recover from the dyspnœa.

Describe the operation.

Cutting through the thyroid or the cricoid cartilage or opening the crico-thyroid membrane is called *laryngotomy*; opening the trachea is called *tracheotomy*; simultaneous opening of the lower portion of the larynx and the upper part of the trachea is called *laryngo-tracheotomy*. In imminent suffocation etherization may be dispensed with. Raise the shoulders and throw the head back. Make a median incision from the crico-thyroid space three inches long. Continue the dissection through the deep fascia, between the sterno-hyoid muscles, until the thyroid gland is exposed. The isthmus may be pushed up, down, or divided between two ligatures. Hook the trachea up with a tenaculum, and open. Prevent blood getting into the trachea by previous double ligature and division of *veins*. A traction ligature inserted into each edge of the divided trachea will prove useful, and may be left after a tracheotomy-tube is introduced. Trachea-tubes are made of hard rubber, silver, or aluminum. They should be double. In an emergency case a quick tracheotomy may be done by steadying the larynx between the thumb and forefinger and making a rapid incision in the median line over and through the crico-thyroid membrane.

What is intubation of the larynx?

The introduction of a metal tube into the chink of the glottis.

Describe the method.

It is done without an anæsthetic. Open the jaws with a mouth-gag. Introduce the left forefinger into the throat, which serves to guide the metal tube, held in the right hand, into the glottis. After the tube is in position the handle by which it is introduced is withdrawn. The tube is provided with a flange, which prevents it slipping downward into the larynx. To this is also attached a silk thread, which is left hanging out of the mouth, and by this thread the tube can be withdrawn at any time. Intubation may prove curative or serve merely as a temporary expedient prior to tracheotomy.

INJURIES AND DISEASES OF THE CHEST.**OF THE CHEST-WALL, LUNGS, AND PLEURÆ.****What are the effects of injuries of the chest?**

Contusions.—Rupture of the lung may occur without laceration of the pleura, causing bloody expectoration, cough, dyspnœa, bronchial râles, and signs of localized pneumonia. Emphysema may occur between the lung and pleura. If the pleura is lacerated blood and air may escape and cause hæmato- and pneumothorax.

Pulmonary or mediastinal abscess or pulmonary gangrene may be a sequence.

Wounds.—Gunshot, stab-wounds, or fracture of the ribs may cause laceration of the lung. The symptoms are those above described for rupture. A wound of the chest below the tenth rib may wound the pleura, perforate the diaphragm, and injure the abdominal organs. If a large blood-vessel of the lung is wounded, blood may fill the bronchial tubes and “drown” the patient. Pulmonary wounds heal as other wounds if kept aseptic.

Describe the principles of treatment.

In hemorrhage from a wound of the lung the blood escapes into the pleural cavity, and causes sufficient pressure to close the bleeding vessel. The escaped blood is absorbed if aseptic. Sepsis produces empyema. Subcutaneous emphysema usually subsides without treatment. For the chest wound, aseptic cleansing, suture,

and dressing. If empyema occurs, irrigation and drainage must be adopted. Bullets, unless easily accessible, should be allowed to remain.

What is the surgical treatment of pleural effusions?

For *serous effusions* aspiration with needle and aspirating pump. The skin at the point of puncture may be rendered insensitive by a local anæsthetic. The puncture should be made close above the border of the seventh rib in the axillary line.

For *purulent effusion* make a two-inch incision in one of the intercostal spaces, sixth to eighth, just in front of latissimus dorsi muscle, and insert a drainage-tube or two tubes side by side. Suture the extremities of the wound, and the drainage-tube to the edge of the skin. Irrigation of the chest-cavity with salicylic or boric-acid solution may be immediate or not till later. Sometimes it is necessary to resect a portion of a rib.

Describe the treatment of (a) pulmonary and (b) mediastinal abscess.

(a) Incise the chest-wall, open the abscess, evacuate the pus, and drain. (b) For mediastinal abscess the incision should be made through the costal cartilages or by trephining the sternum.

OF THE ŒSOPHAGUS.

What are the operations on the œsophagus and their indications?

Œsophagotomy, œsophagostomy, and œsophagectomy.

Œsophagotomy is performed for removal of a foreign body or for the purpose of reaching and cutting a stricture through the opening thus made. When the stricture is cut without such external opening, it is by means of the *œsophagotome*, and the operation is called *internal œsophagotomy*.

Œsophagostomy is indicated only in cancerous stricture of the œsophagus situated *high up*.

Œsophagectomy is resection of a portion of the œsophagus for malignant growth. The lower end of the canal is sutured to the wound-edges. It is very fatal and but rarely performed.

Discuss strictures of the œsophagus.

They are the same as those occurring in the rectum (which see). In addition, spasmodic stricture sometimes occurs in nervous or hysterical patients. In all strictures difficulty in deglutition is the characteristic symptom. Swallowing strong acid, alkaline, or hot

liquids is the cause of cicatricial stricture resulting from the ulceration so induced. Dilatation by bougies is the usual treatment for cicatricial stricture.

The *diagnosis* is made by passing bougies. The *site* is determined by the use of an *olive-tipped* bougie with a slender stem. The tip slips by the stricture, and on withdrawal is caught. The point on the stem corresponding to the teeth is then observed, and its distance from the tip measured after complete withdrawal of the instrument. In the adult of average size the distance from the edge of the teeth to the cardiac orifice of the stomach is between 15 and 16 inches.

Discuss foreign bodies in the œsophagus.

These, of course, occur through accidents in swallowing. The place of impaction should be determined by passing a bougie, and the object removed with the proper instrument, œsophageal forceps, money-catcher, probang, etc. If withdrawal by the mouth is impossible, and the object is comparatively small and without sharp edges, it may be pushed down into the stomach, whence it will pass out in the natural manner. Should neither of these proceedings succeed, œsophagotomy is indicated if the site is sufficiently high. Otherwise, gastrotomy should be performed and the foreign body extracted from below.

Describe œsophagotomy.

The incision is parallel with the anterior edge of the left sterno-mastoid muscle, with its centre at about the level of the cricoid cartilage. The trachea and larynx are retracted inward and the vessels outward when the œsophagus is seen, and opened by a longitudinal incision and the foreign body removed. The œsophageal wound is now closed with sutures over a tube passed down through the mouth or nose, and the outer wound partly sutured and packed with iodoform gauze. The tube is left in situ for several days for feeding purposes.

DISEASES OF, AND OPERATIONS ON, THE AB- DOMINAL VISCERA.

ABDOMINAL SECTION.

Define the term abdominal section.

The term *abdominal section* implies incision of the abdominal

parietes and the opening of the peritoneal cavity, either for the purposes of exploration and diagnosis or with the object of operating upon any of the abdominal or pelvic viscera.

Where may the parietal incision be made?

The incision in the great majority of instances is made in the median line, though it may be made in any part of the abdominal wall. In the absence of special indications always make *the median incision*.

What terms are used for abdominal section?

Laparotomy and cœliotomy.

Define the term laparotomy.

The term *laparotomy*, commonly used for abdominal section, is, strictly speaking, a misnomer. Laparotomy is really an incision in the flank (from *λαπάρα*, the flank), the parts between the short ribs and iliac bones.

What is cœliotomy?

Koilia (*κοιλία*) is the Greek word for the cavity of the belly or abdomen; therefore the proper synonym for the old meaning of the term laparotomy should be kœliotomy, or, as it is anglicized, *cœliotomy*.

How are operations on special organs indicated?

The special operation is sought to be indicated by affixing certain terminal words to the Greek name of the organ. Thus, "tomy," (from *τεμνω*, to cut), "incision," is added to indicate mere incision, as in cystotomy, nephrotomy. The ending "ectomy" (*εξ*, out of; *τεμνω*, to cut) is added to indicate *cutting out* or *removal* of the organ, as in cholecystectomy, nephrectomy, etc. The suffix "stomy" (*στομα*, mouth) indicates the formation of a mouth in a hollow viscus that is intended to be permanent, as in gastrostomy, gastroenterostomy. The termination "orraphy" or "rhaphy" (from *ραφη*, suture) is used to mean *suturing* of an organ for a wound, as gastrorrhaphy; or to fix it, if movable, as nephorrhaphy.

What antiseptic details should be observed in cleansing the skin for abdominal section?

The field of operation should be shaved and thoroughly scrubbed with hot soap and water, then with a 1 : 2000 bichloride-of-mercury solution, after which the skin is washed with ether and alcohol,

then again with corrosive sublimate, and finally irrigated with sterilized water.

How may instruments be sterilized ?

Before every operation they should be cleansed by scrubbing with a brush and soap ; they are then boiled for five minutes in a 1 per cent. solution of sodium carbonate, rinsed two or three times in plain water, and transferred to a tray filled with plain sterilized water.

When is drainage necessary after abdominal section ?

1. In cases where there is likely to be considerable oozing, as from separation of many adhesions ;
2. In cases when a subsequent fistula is inevitable, as in certain operations upon the bowel ;
3. In cases of certain cysts, the walls of which cannot be removed ;
4. In cases which are septic at time of operation ;
5. To guard against secondary hemorrhage.

How is drainage effected in the abdominal cavity ?

By means of a glass drainage-tube or by means of a tampon of iodoform gauze, or by both. Half an inch below the upper orifice of the tube there is a protruding rim, which prevents its slipping into the abdominal cavity.

What is the management of the drainage-tube ?

The tube is introduced as far as the bottom of the pelvis, and secured in the lower angle of the abdominal incision. When there is considerable oozing the fluid should be drawn off through the tube at intervals of half an hour, by means of rubber tubing introduced through the tube to the bottom and attached to a syringe. The glass tube can be removed at the end of twenty-four to forty-eight hours if the amount or character of the discharge permits.

What is the gauze tampon ?

It consists of a long strip of iodoform gauze inserted along the outside of the glass tube, or used alone and packed in from the parietal wound to the bottom of the cavity. It is usually allowed to remain from twenty-four to seventy-two hours.

How should the hands of the surgeon and his assistants be rendered aseptic ?

Scrub the hands and forearm, with especial attention to the nails,

in hot soap and water for ten minutes, rinse in alcohol and ether, and finally immerse in 1 : 1000 bichloride-of-mercury solution.

How should the dressings be sterilized ?

Whenever possible, physical sterilization (that is, by steam, hot air, and boiling water) is preferable to chemical sterilization. All gauze, bandages, cotton, linen gowns, etc. used in and after the operation should be placed in a steam sterilizer at a temperature of 100° C. for at least fifteen to thirty minutes before being used

How should the abdominal wound be sutured ?

Each layer of tissue in the abdominal wall on one side of the wound should be united to the corresponding layer on the opposite side by a separate row of sutures. Thus, in the median line, these layers are peritoneum, transversalis fascia, posterior layer of sheath of rectus, the rectus muscle (the incision is rarely made exactly in the linea alba), anterior layer of its sheath, superficial fascia and fat, skin.

How is the abdominal wound dressed ?

Clean and dry the skin around the wound, dust the line of incision with aristol or iodoform, and cover it with a narrow strip of iodoform or moist sublimate gauze. The whole area around is then covered with plain absorbent gauze, over which is placed a thick piece of cotton dressing. The whole is held in situ by broad strips of adhesive plaster extending halfway around the body, and a binder is put on.

What is the after-treatment of the patient ?

During the first twenty-four hours the patient should be disturbed as little as possible ; nothing should be administered by the mouth except a few sips of iced or hot water ; flatulency, if complained of, is often relieved by an enema of warm water ; a catheter should be passed as often as required.

During the first two or three days the temperature should not rise above 100° or 101° F. ; when it rises above this, and is accompanied by a quickening of the pulse, the administration of a saline purge is indicated, and will prove efficacious unless sepsis in the wound or peritoneum has occurred. Should the peritonitis become severe, the question of reopening the wound and washing out the abdomen should receive serious consideration.

What is the after-treatment of the wound?

If all goes well the wound need not be re-dressed until after the fifth day. The sutures, if silk, may be removed on the eighth day.

In cases that are doing well the diet from the third day should consist of beef-tea, milk, and arrowroot, tea and toast; solid food may be given on the fifth day in small quantities.

OPERATIONS ON THE STOMACH.

Define the various terms used to describe operations upon the stomach.

Gastrostomy means the making of a permanent fistula in the walls of the stomach, opening externally.

Gastrotomy is an incision into the stomach which is afterward sutured.

Gastrorrhaphy is suturing the walls of the stomach for wounds or for extreme dilatation.

Pyloroplasty is incision and transverse suture of the pylorus for fibrous stricture.

Pylorectomy is excision of the pyloric end of the stomach.

Gastro-enterostomy is the operation for making an opening between the wall of the stomach and a portion of the intestinal tract.

What are the indications for gastrostomy?

To prevent starvation by making a mouth in the stomach in case of stricture of the œsophagus or of the cardiac orifice of the stomach.

Describe the operation of gastrostomy.

There are two stages: the *first* consists in opening the abdominal wall, drawing the wall of the stomach into the wound, and suturing it there. The *second* is simply making the opening into the stomach, and may immediately follow the first or not until after two or three days. (For details of suturing see description of *Enterostomy*.) There are three principal methods of performing gastrostomy, differing only as to the *site* of the abdominal incision:

Fenger's Incision.—Three to four inches in length, to the left of the left rectus muscle, and parallel with and about one inch below the border of the left costal cartilages.

Hahn's Incision.—In the eighth intercostal space (left side) after

Fenger's incision has been made. When the stomach is sutured in the former place, Fenger's incision is closed.

Hacker's Incision.—Vertical, three to four inches long, *through the middle* of the left rectus muscle, beginning about one inch below the border of cartilages. The fibres of the muscle act as a sphincter. This is probably the best method.

How is the patient nourished before and after opening the stomach?

Previous to opening the stomach the patient should be fed exclusively by rectal enemata. Peptonized milk, beef-tea, raw eggs, and whiskey are the best articles for this purpose. About four ounces should be introduced every four or five hours. After the formation of the gastric fistula small quantities of liquid food should be injected through the opening by means of a catheter at intervals of every three or four hours. The quantity can be gradually increased, and soon a larger tube with a funnel can be used.

Food which has been chewed, and thus insalivated by the patient, may also be transferred from the mouth to the funnel, and thence into the stomach.

What is gastrotomy?

It is *opening the stomach*, and differs from gastrostomy in that the *opening is subsequently closed*.

What are the indications for this operation?

1. The removal of foreign bodies that are of such a size and shape that they cannot pass through the intestinal tract;
2. The removal of foreign bodies impacted in the œsophagus or in the cardiac opening of the stomach;
3. For the purpose of dilating the orifices of the stomach when they have become contracted by cicatricial growths;
4. For the removal of growths projecting into the cavity of the stomach.

Describe the operation of gastrotomy for the removal of a foreign body lodged in the stomach.

Open the abdomen by an incision three inches in length in the median line or parallel to the borders of the left costal cartilages; or, if the foreign body can be felt, make the incision through the parietes directly over it. When the peritoneal cavity is opened the stomach is sought for and brought into the wound. Two

sutures of silk are now passed through the serous and muscular coats of the stomach at either side of the point selected for incision. Then incise the stomach in a line with the wound and between the two guiding sutures. Introduce the forefinger into the stomach, seek for the foreign body, and extract it with suitable forceps. The foreign body having been removed, close the wound in the stomach by the Czerny-Lembert suture (see under Intestines). Remove sponges and guiding sutures, and close the abdominal wound in the ordinary way.

What is the after-treatment of gastrotomy?

No food should be given by the mouth for three or four days; after that time the diet for two weeks should be of the simplest character, preferably fluid.

Describe the operation of gastrotomy for the removal of foreign bodies impacted in the œsophagus when all attempts to remove them by other means have failed.

Perform gastrotomy; then, invaginating the anterior wall of the stomach, pass the finger or a pair of forceps into the œsophagus and endeavor to dislodge the body. If these means fail, a fine bougie (to whose lower end a strong silk thread is fastened) is passed up the œsophagus from below, past the foreign body, into the mouth. To the silk thread a piece of sponge is attached, and in turn is drawn up the œsophagus from below, dislodging the foreign body and carrying it into the mouth (W. T. Bull).

In some cases it may be necessary to open the stomach, so as to admit the hand, before the removal of the foreign body can be effected.

Describe the operation of gastrotomy, with dilatation of the pyloric orifice of the stomach, in a case of fibrous stricture (Loretta's operation).

Perform abdominal section and separate any external adhesions surrounding the pylorus as far as possible. Open the stomach about two inches from the pylorus and midway between the greater and lesser curvatures. The right forefinger is then introduced into the stomach and pushed into the stenosed pyloric opening, dilating it until two fingers can be introduced or until the fibres begin to yield to the dilatation. The wound in the stomach is then sewn up, the stomach returned to its place, and the abdominal incision closed.

This operation has been, to a great extent, superseded by that of pyloroplasty.

Describe the operation for the dilatation of the cardiac orifice of the stomach.

In operating on a cardiac stricture the gastric incision should be made near the cardiac end of the stomach. If there is difficulty in reaching the stricture with the finger, a pair of dilating forceps should be used, its introduction being guided by the forefinger. The other steps are the same as in the previous operation.

What is the operation of pyloroplasty?

This operation is designed to remove stricture of the pylorus and prevent the possibility of its recurrence. An incision is made through the anterior part of the pylorus in the long axis of the stomach and duodenum, the incision extending on either side of the pylorus one inch along the wall of the stomach and one inch along the wall of the duodenum. The wound is then closed by the ordinary suture in a vertical direction, in the following manner: Hook a tenaculum into the middle portion of the edge of the wound on either side of the incision, and draw the margins of the wound apart, so as to unite the lips of the wound in a line at right angles to the original incision.

What is gastrorrhaphy?

Gastrorrhaphy is suture of the wall of the stomach.

What are the conditions indicating this operation?

1. To close gastro-cutaneous fistulæ or the wounds left open after the operations previously described;
2. To close openings caused by ulceration of the wall of the stomach;
3. In wounds of the stomach caused by bullets, knives, or other means;
4. For extreme dilatation.

What are the symptoms of rupture or perforation of the walls of the stomach?

The *symptoms* are—collapse; a burning pain referred to the region of the stomach; vomiting; symptoms of hemorrhage; tympanites; and subsequent peritonitis.

The operation of gastrorrhaphy in a case of gastro-cutaneous fistula is essentially the same in its details as that for closing a similar opening in the intestine (which see).

What are the steps of the operation of gastrorrhaphy in a case of perforating ulcer or wound of the wall of the stomach?

Open the abdomen by a fairly large incision in the median line. Seek for the perforation. The presence of extravasated stomachic contents in the abdominal cavity will confirm the diagnosis and aid in detecting the perforation. Fluids should be quickly soaked up with sponges. If the perforation is in the anterior wall, it will be easily found and dealt with. If on the posterior surface, the anterior layer of the great omentum must be incised midway between the colon and greater curvature of the stomach. After the opening is found it is treated by inverting the injured portion toward the interior of the stomach, and uniting healthy tissue over it by suture. Should it be found impossible to suture a posterior perforation by raising the stomach, it is recommended to make an opening through the anterior wall of the stomach, and close the posterior opening from the inside of the stomach; the anterior incision is then closed in the usual way. Thoroughly irrigate the abdominal cavity, and drain the lower part of the abdomen or pelvis by means of a glass drainage-tube inserted through the abdominal wall just above the pubes. An additional incision is required for the purpose.

What is gastrorrhaphy for extreme dilatation of the stomach?

This practically consists in "taking a reef" in the anterior wall. A depression is made on the surface of the stomach by means of a steel sound, and the portion above this is brought down and sutured to the portion below along a line of any desirable length, and the sound withdrawn (R. F. Weir).

What is meant by pylorectomy?

It is the removal of the pylorus and as much of the duodenum and wall of the stomach as may be involved in the disease for which the operation is performed.

What are the conditions which call for this operation?

Cancer of the pylorus; rarely for pyloric stenosis or ulceration other than malignant.

Before operating the stomach should be well irrigated with a solution of boroglyceride by means of the syphon stomach-tube.

What are the various steps of the operation?

1. The opening of the abdomen;

2. The isolation of the pylorus ;
3. Exeision of the diseased struetures ;
4. Suturing of the duodenum to the stomaeh ;
5. The closure of the parietal wound.

Describe the opening of the abdomen.

Incision through the parietes over the pyloric tumor, which may be felt, five inches in length, which incision may be transverse or parallel to the border of the right costal cartilages.

At first the ineision should not be made the full length, until after an exploration is made with the finger.

Describe the second stage of the operation.

The isolation of the pylorus sometimes presents great difficulties. Adhesions to adjaecent parts are separated, and the pylorus drawn as far as possible into the wound. The omentum is divided close to the greater curvature of the stomach by catehing up suecessive portions with foreeps and dividing between the foreeps ; each part is then ligatured ; the lesser omentum is treated in the same way, but in both eases the *main vessels* are not to be included. The stomach and duodenum are now elamped upon either side of the portion that is to be removed, and the field of operation is packed around with hot sponges or iodoform gauze.

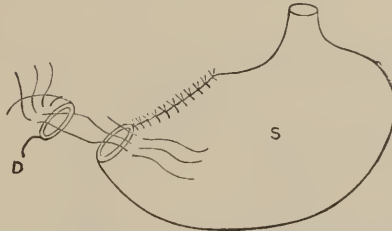
Describe the excision of the diseased parts.

Both walls of the stomach are divided with seissors three-fourths of an inch away from the borders of the growth, the exaet direction of the cut depending upon the shape of the tumor and the point at which the duodenum is to be inserted into the divided end of the stomach ; bleeding vessels are secured with pressure foreeps, and subsequently ligatured if neecessary ; the cut is made obliquely from above downward, and from the left to the right ; at first divide at this stage only about two-thirds of the diameter of the organ. The wound made in the stomaeh is at once closed by means of a Czerny-Lembert suture. When the sutures are in place, the remaining part of the stomaeh, reduced now to about the size of the ealibre of the duodenum, is also divided.

The duodenum is now divided by an oblique incision, which runs from above downward and to the right, and corresponds in size to the ineision in the stomach ; the growth is removed, and the margin of the orifice in the stomach is now adapted to the eut edge of the duodenum, and as many sutures as it is possible to insert

from the inside are passed. The lips of the incision are inverted so as to bring peritoneal surfaces into contact; the first row of stitches is inserted and tied from the mucous aspect; the remaining sutures are applied from the outside, and, however inserted,

FIG. 110.



The Best Mode of Uniting the Stomach and Duodenum after excision of the pylorus and much of the lesser curvature. Three Lembert sutures are in position: *D*, duodenum; *S*, stomach.

are essentially the Czerny-Lembert suture. The needle should pierce each layer about a quarter of an inch from the cut edge; after these sutures are inserted a second row of Lembert sutures should be inserted from without. Extra sutures should be introduced at any point where the union appears weak. The sutures through the serous surfaces should be introduced with a round milliner's needle (Fig. 110).

Describe the fourth stage.

After the edges of the omentum are united to the edges of the altered stomach, the whole field of the operation should be carefully cleansed and the incision in the parietes closed in the ordinary way.

What is the after-treatment?

For the first few days all food by the mouth should be withheld, and the patient supported by nutrient rectal enemata; after that time pancreatized milk can be given by the mouth in tablespoonful doses every hour, and the quantity gradually increased.

What is the mortality of this operation?

The mortality is about 76 per cent.

What is gastro-enterostomy?

It is the establishment of a permanent fistula between the stomach and some part of the small intestine.

What are the indications calling for this operation?

This operation is a substitute for pylorectomy when excision cannot be performed; it may also be indicated in any form of pyloric obstruction.

(In certain cases after resection of the carcinomatous pylorus an anastomosis is made between the stomach and duodenum after turning in the cut ends of each, and thus forming blind cul-de-sacs.)

Describe the operation.

A median incision is made extending from the ensiform cartilage to the umbilicus. The first loop of small intestine sufficiently free to permit easy apposition is now selected. This loop of intestine and a portion of the stomach close to the gastro-colic fold are withdrawn from the abdomen and surrounded with warm sponges. Now pass a piece of india-rubber tubing through the mesentery at each end of the selected loop, and, having emptied the included portion of gut by gentle pressure, draw the ends of the tubing sufficiently tight to prevent any passage of the bowel-contents into the loop to be operated upon. The stomach should have been previously emptied. The intestines and stomach are now laid together at the points where communicating openings are to be made, and are united by sutures exactly as described in "Lateral Anastomosis" of the Intestines (which see).

In what other way can the anastomosis be effected?

An anastomosis between the stomach and intestine can be effected by any of the means described under Operations on the Intestines.

OPERATIONS ON THE INTESTINES.**What are the principal operations on the intestines?**

The chief operations on the intestines may be classed under the following headings: Enterorrhaphy, enterectomy, enterotomy, and enterostomy.

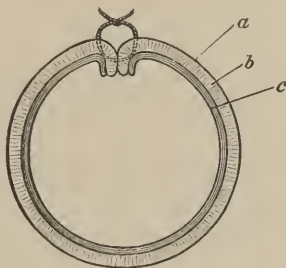
What is enterorrhaphy?

It is the suturing of the intestine, either for closing a wound, or for the uniting of the divided ends after resection of a portion, or in performing lateral anastomosis.

What is the fundamental principle of all intestinal suture?

Lembert was the first to show that in order to secure union it is absolutely necessary that the serous coats of two wound-edges should be brought into the closest apposition: for this purpose the stitch must, including the muscular coat also, be so inserted as to double in two opposing margins and bring serous surfaces flat to-

FIG. 111.



Lembert's Suture: *a*, serous, *b*, muscular, and *c*, mucous coat (Smith).

gether, while at the same time the mucous coat must not be included, lest the intestinal contents enter the track of the thread and infect the wound and the peritoneum. (See Fig. 111.)

Describe the application of the interrupted Lembert suture in the case of an intestinal wound.

The needle is passed transversely to the line of the wound. The needle punctures a fold of the peritoneal and muscular coats on one side of the wound, and is then carried over to the opposite side of the wound, where a similar fold is picked up. (See Fig. 112.)

When a sufficient number of sutures have been placed, the margins of the wound are turned in and the serous surfaces drawn together by tying the sutures. The width of the fold picked up should be about one-eighth of an inch (3 mm.), and the inner row of needle points should be one-twelfth of an inch (1 mm.) from the edge of the wound. The stitches should be placed at intervals of one-tenth of an inch (2 mm.).

FIG. 112.

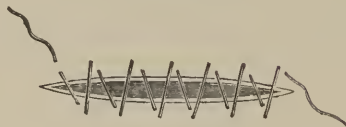


Lembert's Suture (Ashhurst).

Describe the continuous suture.

The edges of the wound are turned in and held by an ordinary

FIG. 113.



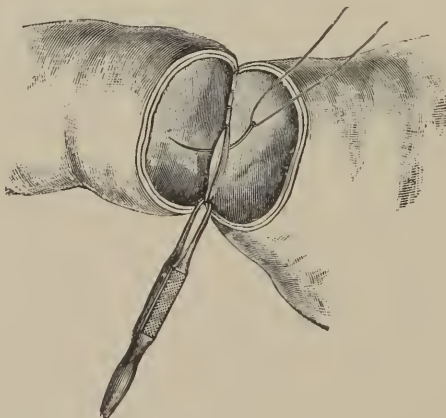
Dupuytren's Suture.

continuous suture, which picks up a fold of the serous membrane on either side, and does not penetrate the mucous membrane. (See Fig. 113.)

What is the principle of the Czerny suture?

In order to unite the mucous membrane, Czerny reinforces the Lembert suture by the addition of an inner row of interrupted sutures. The knots of this inner row are, in suturing complete

FIG. 114.



Pylorotomy: manner of introducing Woelfler's sutures (Billroth).

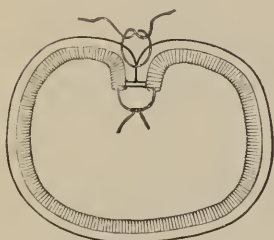
resection, turned inward. (See Fig. 114.) Czerny advised that this deep suture should include all the intestinal coats, but it is best to

include the mucous coat only. (See Fig. 115.) A similar continuous suture may be used.

What is Halstead's plain quilt-stitch suture?

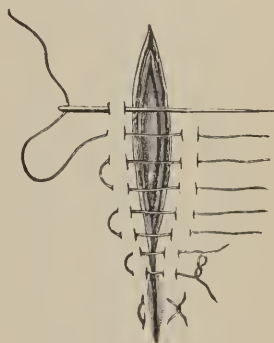
This may be seen by reference to Fig. 116. All the stitches should be placed before a single one is tied, in order that they may

FIG. 115.



Czerny-Lembert Suture.

FIG. 116.



Halstead's Plain Quilt Suture.

all be applied in a straight line. Each stitch should pick up a portion of the submucosa.

What artificial aids have been devised to assist in suturing the intestinal canal in "lateral anastomosis"?

Numerous methods have been introduced to facilitate this operation (which see). Those in most common use are: Senn's bone-plates; Abbé's eatgut rings; Brokaw's segmented rubber rings; Robinson's plates of raw hides; Davis's solid eatgut plates; Dawbarn's raw potato plates; Von Baracz's raw Swedish turnip; Murphy's "anastomosis button."

What advantage is claimed for the plates and rings over that of the ordinary suture?

A saving of time in what is usually a prolonged operation. But, though intestinal anastomosis by the use of artificial aids is perfectly feasible, and many successes with them have been reported, yet the majority of surgeons prefer to trust to the absolute security afforded by the method of *simple unaided suture*.

What material is used for the intestinal suture?

The best is silk, either fine Chinese twist or black embroidery silk made aseptic by boiling. Black is better than white, because it contrasts more strongly with the parts to be sewed and can be more easily seen.

Catgut is used by many surgeons, but it has certain disadvantages. It is more rigid and unyielding, and when tied forms a large clumsy knot, which is more liable to give way than silk.

A full curved needle is more convenient for the introduction of sutures in the mucous membrane.

The simplest possible form of needle-holder should be used.

What are omental grafts? and how are they used?

Senn has advised that after all intestinal sutures a flap of omentum be fixed over the line of union. These flaps soon become adherent, and prove an additional safeguard against perforation and leakage. These flaps are one and a half to two inches in width, and are fixed in position by a few catgut sutures. In circular enterorrhaphy they should encircle the bowel, and are fixed in place by two catgut sutures passed through both ends of the graft and the mesentery. The grafts are completely severed from the omentum.

Define the terms enterectomy, colectomy, and cæcectomy.

The excision or removal of a portion of the small intestine is enterectomy or resection. When a piece of the large intestine or colon is resected the operation is called colectomy. Excision of the cæcum has received the name of cæcectomy.

In what conditions of the bowels is resection indicated?

Malignant growth; in gangrene of a portion of the intestine due to strangulation of any kind. It may in certain cases be the necessary termination of an operation designed to relieve intestinal obstruction, as in cases of stricture of the bowel both simple and epitheliomatous; in occlusion due to peritoneal adhesions and neoplasms; in irreducible intussusception; in cases of extensive injury from gunshot and lacerated wounds; in impacted foreign bodies; or in cases of a perforating ulcer.

In case the patient is so exhausted that a prolonged operation would be likely to cause death, the formation of an artificial anus should be established as a palliative measure, so as to tide the patient over the danger of death from obstruction. In cases of

malignant disease where the patient is exhausted this would be a safer procedure, to be followed by enterectomy when the patient is in an improved condition.

The general mortality of these operations is about 50 per cent.

What are the three stages of the operation of resection of the bowel for any cause, followed by immediate suture to each other of the cut ends thus left?

1. Isolation of the bowel-loop that is to be excised;
2. Resection of the same;
3. Suture of the divided ends to each other, or *circular enterorrhaphy*.

Describe the method of isolating the portion to be resected.

Open the abdomen and draw the loop to be operated upon well out of the parietal wound, so as to bring a healthy portion of bowel into view. In a case of herniotomy, if this cannot be done through the original wound, a median abdominal section should be made, so as to give free access to the viscera.

Any recent adhesions should be separated with the finger. Firm adhesions fixing the portion to be resected to other loops and to the solid viscera are a contraindication to the operation.

In cases of malignant disease, if the mesenteric glands beyond the limits of the diseased portion are involved, the operation should be abandoned.

If the intestinal contents have been extravasated into the peritoneal cavity, this matter should be removed and the peritoneum cleansed before proceeding to the resection.

In case the gangrenous portion is very extensive or so firmly bound down as to be immovable, the operation is to be abandoned.

Fix the limits of the part to be resected, draw this portion outside the abdomen, clear it of its contents by gentle pressure with the finger, place it on a warm sponge, and pack all around the abdominal opening with sponges, so that no intestinal matter can escape into the peritoneal cavity.

Describe how the diseased portion is resected.

Place some form of intestinal clamp on the healthy bowel above and below the seat of disease.

Many forms of intestinal clamps have been devised: Abbé's, Makin's, Brokaw's, and Newell's are all good. Senn uses a rubber band. Many surgeons prefer a ligature of tape or a strip of gauze

perforating the mesentery and tied in a single loop knot around the bowel. The fingers of an assistant will aid the constriction by the clamp, but they are not to be relied upon solely.

In cases of great distension of the bowel and accumulation of the intestinal contents the bowel should be incised and emptied of its contents away from the abdominal wound. The bowel above the resection area should also be emptied of any accumulation before the resection is made.

The bowel is then cut straight across from the free border to the mesentery. The mesentery of the resected portion may be divided close to the wall of the bowel, or a triangular portion of the mesentery may be removed with the resected bowel. The base of the triangle of removed mesentery is next to the intestine, and should be narrower than the length of bowel removed. This provides a greater vascular supply for the divided ends of the bowel that are left. It is claimed that division of the mesentery along the wall of the bowel involves less division of vessels, and therefore less risk of gangrene.

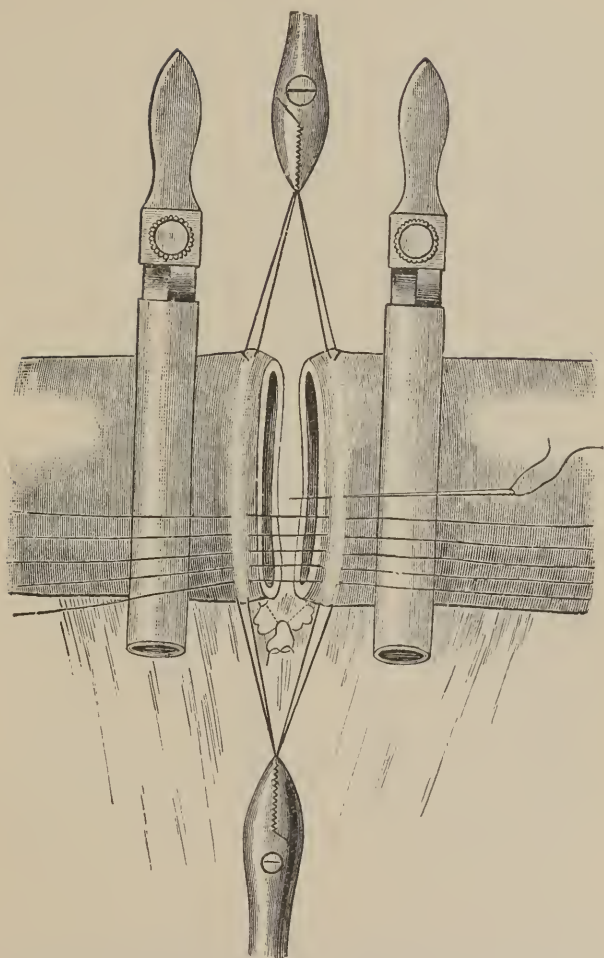
Bleeding vessels in the bowel should be picked up with pointed forceps and clamped. Vessels in the mesentery should be clamped, and subsequently tied with catgut ligatures. Another method is to pass fine catgut ligatures around the vessels of the mesentery, and thus secure them before the triangular portion is removed.

The triangular gap in the mesentery should be closed with a continuous suture. If the mesentery is divided next to the bowel, the edges are united by a continuous suture and the redundant mesentery folded together by sutures transfixing the two layers at its base.

Describe the method of circular suture of the divided ends of the bowel.

Thoroughly cleanse the ends to be sutured by irrigating with a tepid salt solution (6 : 1000). Then unite the mucous membrane by a continuous or interrupted suture, the needle punctures placed three-sixteenths of an inch apart. Then unite the serous surfaces by a second row of Lembert sutures placed one-eighth of an inch apart (Fig. 117). Unite the parts at each side of the mesenteric border first; here special care should be exercised to cover the bare portion of the bowel by a fold of peritoneum from the mesentery, using two or three extra sutures for this purpose.

FIG. 117.



Drawing to show Method of Suturing Bowel after Resection (Greig Smith).

The other sutures are put in place and tied, so as to unite firmly and securely the divided ends of the bowel.

The intestinal clamps are now removed, the parts are again irrigated, and returned to the abdominal cavity. Remove all sponges and close the abdominal cavity in the usual way. A drainage-tube is *not* used unless there is some *special indication* for the use.

To facilitate the insertion of the sutures various devices have been used to distend the bowel, such as a plug of cocoa-butter, the trachea of an animal, an inflated rubber bag, etc., but they are not essential.

What is the after-treatment of the patient ?

The stomach and bowels are put at rest, and the patient is nourished by nutrient rectal enemata, and after a few days by artificially digested foods by the mouth. Large doses of opium are sometimes given to restrain intestinal movements.

The patient must lie absolutely quiet on his back.

What is lateral anastomosis ?

It is the method of uniting two portions of the intestine by suturing together the edges of the openings made in them. Its indications are the same as for enterectomy or resection. There are two methods of performing lateral anastomosis :

(1) *After resection* it is used as a *substitute* for circular enterorrhaphy ; that is, the cut ends of intestine remaining after the resection are each *closed completely* by turning in and suturing its edges, and then the two loops are placed side by side, the closed ends looking in opposite directions, and united by sutures after an opening has been made in each.

(2) There is *no resection made*, the affected portion is left *in situ*, and the parts of the intestine above and below this affected portion are united as above described. Malignant tumor, which on account of adhesions and size cannot be removed, is the usual condition for which this second method is used. "Short circuiting" is a term at times applied to this method.

Give the principal points of the technique of "lateral anastomosis."

Place the loops of intestine side by side, and unite them by a continuous Lambert suture for a distance of five inches. This suture should be placed at about one-fourth of an inch from the

middle line of the free border of the gut. Leave the end of this suture long—that is, only one-half of it should have been used—and with the needle in place. Then apply another *exactly similar* suture close to the first one, but running in the *opposite* direction. The loops of intestine are now incised exactly in the middle line, the length of the incision in each being four inches. Another silk suture is now started at one corner of the openings, and unites by a quick overhand stitch the two cut edges lying next the first rows of sutures. The needle pierces both mucous and serous coats, and thus secures the bleeding vessels, from which the clamps, if it has been necessary to apply them, are removed as the needle reaches them. Each of the remaining two cut edges is similarly sutured, and each with its own separate suture. The portions of the intes-

FIG. 118.

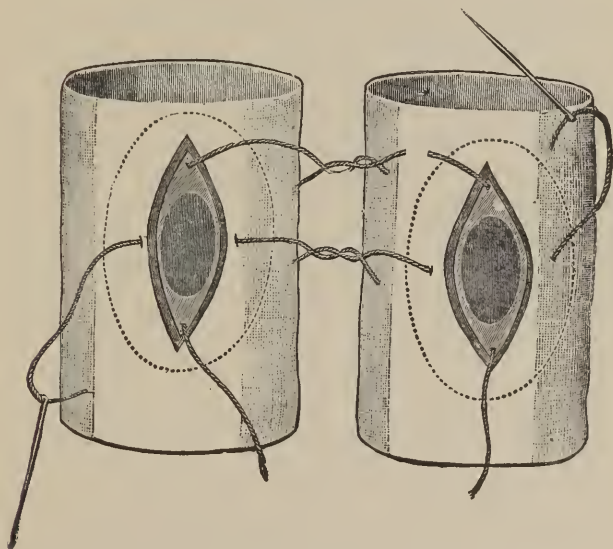


Diagram of Method of Using Decalcified Bone-Plates of Senn (Greig Smith).

tine beyond these last-mentioned cut edges, and at a quarter of an inch *from* them, are now united by the *long ends* of the *original*

sutures, the one lying nearest the cut edges being used first. The procedure is now complete, except for the return of the bowel and closure of the abdominal wound (R. Abbe).

(For a diagram illustrating lateral anastomosis by Senn's bone-plates see Figs. 118 and 119.)

FIG. 119.

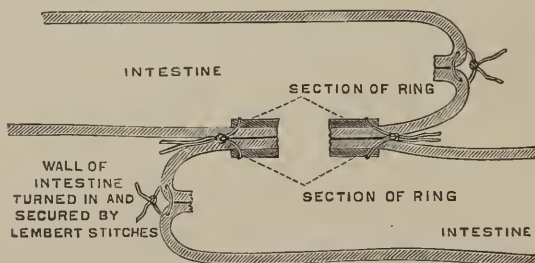


Diagram showing Position of Decalcified Bone-Plates in intestinal anastomosis after resection of bowel.

Describe the operation of enterectomy with the formation of an artificial anus.

In certain cases the patient is so exhausted that a prolonged operation with suture of the intestine, on account of the time necessarily consumed, would cause death. Hence this operation, being quicker and safer, is to be chosen. It consists in resecting the diseased portion of bowel and the formation of an artificial anus.

Open the abdomen and resect the diseased intestine as in the previous operation.

If we resect a triangular piece of the mesentery and suture the gap left, it will greatly facilitate the subsequent operation for closure of the artificial anus.

The extremities of the parietal wound are now closed, so as to leave just enough space for the ends of the divided gut to project; the two segments of bowel are then united along their mesenteric border by a few points of suture. The cut edges of mucous membrane where the adjacent segments come in contact should also be united by a continuous suture. Then the ends of the segments of bowel should be fixed in the parietal wound by means of *inter-*

rupted sutures. The needle transfixes in successive order the *skin*, *tissues* of the *parietes*, *parietal peritoneum*, then the *whole thickness* of the *wall of intestine*, thus bringing the serous surfaces of bowel in contact with that of the parietes.

Finally, the mucous coat of the intestine is united to the skin in the gaps between the former sutures.

Describe the various methods of uniting the segments of intestine when they are of unequal size.

The bowel above the resected segment will frequently be found dilated and of a much larger calibre than that of the tube below, so that the two ends to be united in circular enterorrhaphy are of unequal size. To meet this obstacle various substitutes for this operation have been devised :

(1) Wehr recommended that the end of the narrower tube be divided obliquely, so that the lumen of the oblong opening shall correspond to that of the larger tube.

(2) Billroth devised the method of *lateral implantation*. In a given case, assuming that the cæcum has been excised, the end of the colon is closed by sutures. A longitudinal slit is now made in the wall of the colon of such a size that it will correspond to the lumen of the divided end of the *ileum*, which is then implanted in this slit in the colon and fixed there by sutures.

What is enterotomy?

This means *incising the intestine*, which is followed by suturing the opening thus made. The indications are usually for removal of a foreign body or for relieving over-distension by evacuating intestinal contents.

What is enterostomy?

Enterostomy consists in making an opening in the bowel, and keeping this opening *permauent* by stitching it into the abdominal wound. The operation is done in certain cases of intestinal obstruction. "Enterostomy" is the proper term for this operation, but "enterotomy" is often, though incorrectly, used.

In what part of the parietes is the abdominal section usually made?

The abdomen may be opened in the median line or in any part, but the right or left iliac region, just above Poupart's ligament, is often selected.

Describe the operation of enterostomy.

The abdomen is opened by an incision one inch and a half to three inches in length, and the nearest distended loop of intestine, usually the lower part of the ileum, is drawn into the wound and held. Now close the parietal wound except at the middle portion, where the gut is to be fixed. Suture the edges of the parietal peritoneum all around to the margins of the skin of this middle portion. Now suture the *wall of the bowel* to the margins of the skin on all sides, so as to secure close apposition of serous surfaces.

The stitches should pierce the skin, the parietal peritoneum, and the serous and muscular coats of the bowel. *These sutures should not enter the lumen of the intestine.*

Before the intestine is opened the edges of the wound should be thickly covered with iodoform. The bowel is then opened in the centre of the exposed portion and the intestinal contents allowed to escape. To strengthen the fine sutures that have already been placed four additional sutures should be now introduced. These should take a firm hold of the skin and transfix the whole thickness of the intestinal wall. A light dressing of absorbent gauze should then be used.

The contents of the intestine should not be pressed out, but should be allowed to escape without any interference.

In cases of extreme exhaustion the operation has been done under cocaine anæsthesia.

Duodenostomy and *jejunostomy* are forms of enterostomy performed in cases of pyloric stenosis for the purpose of artificial feeding.

An oblique incision is made as for pylorotomy, the transverse colon is drawn upward, and the omentum is pushed to the left.

In any case in which the operation of pylorotomy or gastro-enterostomy is commenced, and, after exploration, found to be impracticable, it may be advisable to give the patient the chance of prolongation of life by choosing to do either a jejunostomy or a duodenostomy.

Define the terms fæcal fistula and artificial anus.

An abdominal opening discharging fæcal matter and leading into the intestine by a *tract* is a *fæcal fistula*.

An abdominal opening which is situated directly between the intestinal canal and the outer air, through the parietes, is called an

artificial anus. Such openings are left after enterostomy or colostomy, and are made intentionally, or they may be the result of disease or accident.

The skin surrounding the fistula or false anus is usually the seat of an *eczematous inflammation* caused by the irritating discharges.

The parietal peritoneum around the opening is adherent to the bowel over a varying extent, and the portion of the parietal wall

FIG. 120.

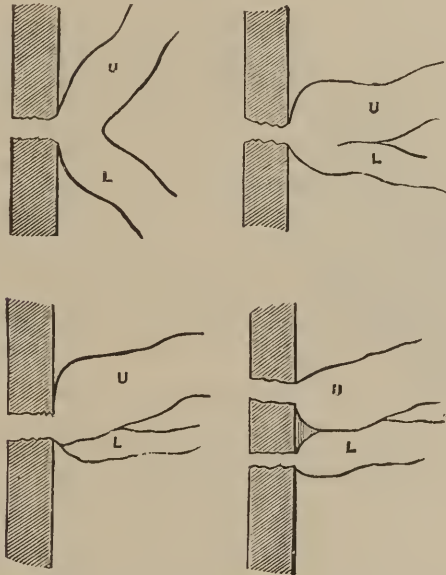


Diagram showing various relations of upper (U) and lower (L) portions of intestine with spur (Greig Smith).

in which the fistula is buried is changed and altered by inflammation. Sometimes the opening in the bowel is double, from the two parallel intestinal tubes, as in a case where a resection of bowel has been made for gangrene or other disease.

Usually the continuity of the bowel above and below the fistula

is interrupted by a *spur* or *septum* formed by intestinal wall bent inward and the two serous surfaces thus placed in contact subsequently coalescing. It is this spur which tends to cause extrusion of the entire faecal contents through the abnormal anus. If this is absent, the faecal contents may continue down the tube and escape in the normal way, per rectum, with very little passing through the abdominal opening.

In other cases there is but a *small loss of substance* in the wall of the bowel, and the intestine is not acutely bent on itself. Between these two conditions there are many varieties, as illustrated in Fig. 120.

The spur *increases in size* with the duration of the disease, being dragged down by the faeces, while at the same time the bowel above the opening becomes dilated and more vascular, and that portion below becomes shrivelled and collapsed. Hence it is important that an operation for obliteration be done early, before these changes take place.

This spur is the chief obstacle to the *spontaneous cure* of artificial anus, in many cases making it necessary to resect and suture the intestine.

What are the indications for operation in a case of faecal fistula or artificial anus?

1. The desire to get rid of a loathsome or worrying complaint;
2. Emaciation from loss of chyle when the opening is in the jejunum or upper ileum;
3. Liability to prolapse of the bowel or hernia.

What are the simple operations for closing a faecal fistula or an artificial anus when there is free communication between the upper and lower segments of bowel?

1. Freshening the edges of the fistula by means of the actual cautery;
2. Paring the edges of the fistula and uniting them by suture;
3. Covering the opening by flaps of skin dissected from the surrounding integument after paring and uniting the edges of the fistula by suture. In this method two flaps are used, one turned on its face over the opening, and the other laid by its raw surface over the surface of the other.

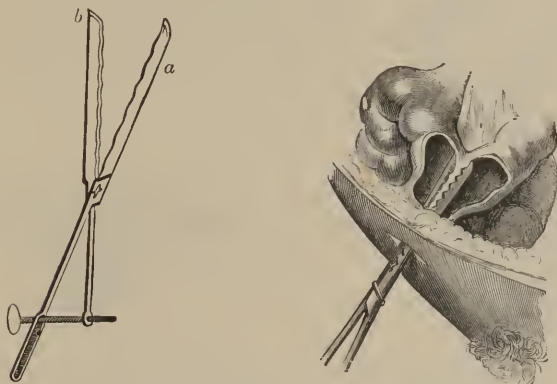
What is the method of treatment where a spur exists?

1. Depression of the spur by elastic pressure. The simple method is to insert a piece of thick rubber tubing, bent in the form

of a horseshoe, into the two openings. As it tends to straighten itself, it obliterates the spur by pressure and absorption. The tube can be removed at any time by means of a string which has been attached to it and carried out of the opening.

2. Destruction of the spur by the enterotome. This destroys the spur by slow crushing. Its use is not unattended with danger. The blades of the instrument are made to include the spur, and are left in position until by their compression they cause sloughing of the included tissue. The mortality from their use is about $8\frac{1}{2}$ per cent. (Fig. 121.)

FIG. 121.



a, Enterotome; *b*, enterotome applied. (Ashhurst.)

3. *Resection and suture of the intestine.*

This procedure is indicated when other methods fail, and in those cases where there has been a great loss of substance it will be the only means offering a prospect of cure from the outset.

Describe the steps of the operation.

Two days previous to the operation, measures should be instituted to empty the bowel thoroughly and purify the wound. During this period the patient should be fed by rectal enemata. Just before operation the bowel should be irrigated with warm water, and the skin around the opening sterilized in the usual manner. Plug each segment of bowel with a sponge attached to a string. Make two

vertical incisions through the abdominal wall, on each side of the fistula, elliptical in shape and circumscribing the abnormal opening (Fig. 122).

The abdominal cavity must be opened with the *utmost caution*, so as not to wound any coils of intestine which may be found adherent, and when entered through one of the lateral cuts the fingers may be introduced and the parts explored.

FIG. 122.



Method of Closing an Artificial Anus. *a*, eczematous skin around faecal fistula; *d*, *c*, skin-wound.

The wound in the skin is gradually deepened and extended through the parietes and peritoneum on all sides. A little tissue is thus isolated, and still remains adherent to the margins of the openings in the entering and returning portions of bowel (Fig. 123).

FIG. 123.



Method of Closing an Artificial Anus. *a*, skin with faecal fistula; *b*, tissue around the sinus; *c*, bowel with internal orifice of the sinus.

The bowel is now liberated from surrounding adhesions, and with the island of skin attached drawn out through the wound, and packed around with warm sponges so as to isolate it from the abdominal cavity. The gut is then clamped above and below the opening, and the sponges removed which have been used to plug its lumen. The "island of skin" (Treves), together with the tissue of the sinus, is now cut away from the intestine, and the elliptical opening thus made in the gut is closed by suture.

In the case of a small fistula, where there has not been much destruction of intestinal wall, it will be possible to incise the margins of the opening in the bowel by an elliptical incision, and

unite the wound-edges by a double row of Lembert sutures, as in the case of an ordinary intestinal wound.

If there has been an extensive loss of the bowel-substance, it will be necessary to resect a portion of gut, including the fistula, and restore the continuity either by circular enterorrhaphy or by lateral anastomosis.

What is colectomy?

Resection of a portion of the colon.

What are the indications for this operation?

Malignant disease is the chief indication. Usually the length of bowel removed is from two to twelve inches. At the conclusion of the operation an artificial anus may be established, or the ends of the resected intestine may be united by circular suture or by lateral anastomosis.

What is the best location for the parietal incision?

For anatomical reasons an incision over the site of the tumor should be selected. If for any cause the situation of the tumor cannot be located by palpation, a small exploratory median incision may be made, and, after the position of the tumor is defined, this may be followed by a second incision over the seat of the disease. (For details of the operation, see description already given of Enterectomy.)

Define the term colostomy.

When an opening is made in the colon for the purpose of giving exit to the fæces, the more correct surgical term for the operation is *colostomy*, though *colotomy* is more commonly used.

The *new anus* may be made on either side in the *lumbar* or *inguinal* region. At times the anus is made in the *median line*, when the term *median laparo- or œlio-colostomy* is used.

When the *artificial anus* is made in the *lumbar* region, it is called *lumbar colostomy* (Amussat's).

When the *artificial anus* is established in the *inguinal* region, it is properly termed *inguinal laparo- or œlio-colostomy* (Littre's operation).

What are the indications for colostomy?

The cases in which this operation is indicated are—ulceration of the rectum; excessive distension from faecal impaction; recto-vesical fistula; cancer of the rectum; intestinal obstruction of the

colon from any cause; in imperforate anus or atresia ani, where restoration in normal position is impossible.

What is the anatomical position of the ascending or descending colon?

Its position may be approximately represented by a vertical line drawn upward to the last rib from a point half an inch behind the centre of the crest of the ilium (the point midway between the anterior and posterior iliac spines).

Describe the operation of lumbar colostomy.

The patient should lie on the sound side, in the semi-prone position, with a round pillow placed under the opposite loin, so that the last rib may be separated as widely as possible from the crest of the ilium, and thus afford the greatest possible space for the operation.

The incision is made obliquely, midway between the crest of the ilium and the last rib, commencing one inch in front of the anatomical position of the colon, and extending upward and backward toward the angle formed by the last rib and the spine. It should be from two to four inches in length. The tissues should be divided until the edge of the quadratus muscle is reached.

The transversalis fascia is now divided, when the subperitoneal fat is reached. It is sometimes advisable to distend the colon at this stage by air introduced per rectum. If the colon does not bulge forward into the wound, it may be sought for with the finger, and will be found in a plane anterior to the lower border of the kidney. Care must be taken in separating the subperitoneal fat that the peritoneum is not opened.

Deep pressure on the anterior wall of the abdomen will aid in making the colon appear in the wound.

If the peritoneum should be accidentally opened, the edges of the wound should be caught up with pressure forceps and secured with a ligature.

The colon must be opened on its posterior wall, in the portion uncovered by peritoneum. (The further details are as given in Enterostomy.)

What means are taken to prevent the collection of fæces in the bowel below the artificial opening?

Some surgeons have advised that the colon be divided and the lower end completely closed by sutures and dropped back in the

abdomen. In most cases the disturbing symptoms produced by faeces passing into the lower segment of the colon may be prevented by frequent irrigation. A subsequent operation for the closure of its upper extremity may be made.

Describe the operation of inguinal laparo-colostomy.

As a guide, draw an imaginary line from the anterior superior spine to the umbilicus; the *incision*, two and a half inches in length, crosses this line at right angles one inch and a half from the superior spine.

The abdomen having been opened, the colon may be recognized by its longitudinal bands, its glandulae epiploicae, and its regular convoluted surface. Sometimes it can be detected by the hard, scybalous masses within. The colon being found, a loop of it is drawn into the wound. In order to avoid the prolapse which is likely to occur if loose folds of the sigmoid flexure remain immediately above the abdominal opening, gently draw out as much loose bowel as will readily come, and pass it in again at the lower angle. Then make the opening in the gut, and suture in the manner already described for Enterostomy. It is best to pass two provisional ligatures of stout silk through the colon, as they help to steady the bowel during its subsequent stitching to the skin.

The mortality of this operation is only about $2\frac{1}{2}$ per cent.

Describe some of the modifications of this operation.

Some surgeons advise a vertical incision in the linea semilunaris. Allingham draws a loop of the sigmoid well out of the wound, and secures it by means of a strong thread which transfixes the mesocolon. Maydl, in order to hold the intestine up in the wound, passes a rod of hard rubber, wrapped in iodoform gauze, under the loop and through a slit in the mesocolon.

When the operation is made on the right side the caecum is opened, and the steps of the procedures are the same as above described.

INTESTINAL OBSTRUCTION.

Define intestinal obstruction.

By this term is meant such a condition of a portion of the intestines that the passage through it of its contents is prevented and a stasis of its blood-supply produced. Obstruction produced by a portion of bowel protruded through an opening in the abdominal parietes is called "strangulated hernia."

What are the causes of intestinal obstruction?

For purposes of convenience they are grouped into three classes: (a) those occurring *within the lumen* of the gut; (b) those having their seat *in the wall* of the gut; (c) those which are entirely *external* to the gut. Thus:

Class (a)	{	Fæcal impaction. Foreign bodies. Enteroliths. Gall-stones. Pedunculated tumors.	
Class (b)	{	Cicatricial contraction of ulcers.	{ Typhoid, Dysenteric, Traumatic, etc.
	{	Presence of tumors.	{ Epithelioma. Carcinoma. Sarcoma. Adenoma. Lipoma. Angioma. Cysts. } Rare.
	{	Volvulus. Intussusception. Adhesions (peritoneal surface).	
Class (c)	{	Bands. Apertures. Pressure of tumors variously located.	

These causes will now be discussed in detail.

What are the various foreign bodies usually found obstructing the lumen of the intestines?

Foreign bodies of various kinds which have been swallowed; gall-stones and intestinal calculi or enteroliths; impaction of an accumulated mass of fæces. Pedunculated polypi sometimes cause obstruction.

What are the causes producing simple or malignant stricture of the bowel?

Cicatricial contraction may result from an old ulcer, or organization of inflammatory exudate following enteritis, or from an old

hernia. Contraction may also be caused by a new growth, benign or malignant. The benign forms are adenomata, fatty, cystic, and vascular tumors. The malignant forms are epithelioma, carcinoma (scirrhus or encephaloid), sarcoma, and lympho-sarcoma.

What is volvulus?

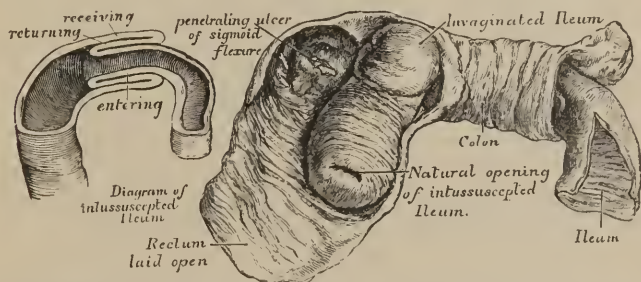
Volvulus is torsion of the bowel, or rotation around its axis of attachment in such a manner as to cause strangulation and occlusion. This most frequently occurs in the *sigmoid flexure*. It is often produced by sudden jars or falls of the body. Excessive amount of feces in the portion to be involved favors its production.

What is intussusception?

Intussusception or invagination of the intestine means the prolapse or telescoping of one part of the bowel into the lumen of the part above or below. The portion pushed inside consists of an entering and returning layer, and is called the *intussusceptum*.

The sheath or containing cylinder is called the *intussusciens*. The *neck* is at the entrance of the invagination (Fig. 124). The

FIG. 124.



Intussusception, with a diagram showing the entering, returning, and receiving layers of ileum into colon (Bryant).

invaginated portion becomes congested and undergoes inflammatory changes, which result in the formation of adhesions, strangulation, and finally gangrene and sloughing of the invaginated portion.

Intussusception is one of the most common forms of intestinal obstruction, and may occur—1, in the small intestine: 2, in the colon or rectum; 3, in the ileo-cæcal region. The latter is the most frequent site.

If the *valve* is the part *farthest pushed in*, i. e. is the *end* of the intussusceptum, the intussusception is called *ileo-cæcal*, but if a portion of the ileum which has *protruded through* the valve is the "end," it is called *ileo-colic*.

This is the common variety in children. It may be so extensive that the valve appears at the anus.

What are adhesions?

Patches of fibrinous peritonitis occur on the surface of the intestine in various places as the result of ulcers or other morbid processes within the gut. Such patches, coming in contact with the parietal peritoneum or with contiguous coils of intestine, contract adhesions to the same. In course of time these adhesions become organized, and of sufficient strength oftentimes to cause kinks or indentations in the intestinal wall deep enough to bring about obstruction.

Describe the various forms of bands and apertures, and the mechanism of obstruction by them.

Various bands are formed from organized inflammatory exudation due to a previous peritonitis. These bands may be attached

FIG. 125.



FIG. 126.



FIG. 127.



Simple and Complicated Knots, formed by a free diverticulum with ampullary end.

FIG. 128.



A Simple Noose formed by a long cord.

FIG. 129.



More Complicated "Knots," by cords (Treves).

FIG. 130.

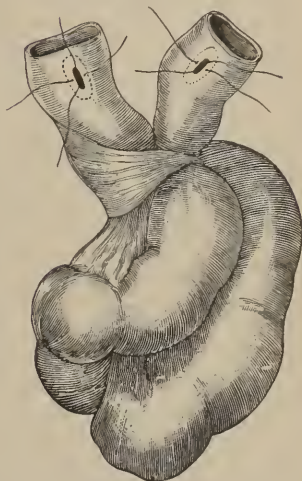


by both ends, or one end may be free. If the former, one end is always attached to the intestine, and the other end is fastened either

to a contiguous coil of intestine or to the parietal peritoneum. A portion of the bowel is caught in such a band, and its lumen and circulation are obstructed (Figs. 125-130). Omental and mesenteric adhesions may obstruct a portion of bowel in the same way. Abnormal adhesions of Meckel's diverticulum may be a cause of obstruction. Adhesions of normal structures, as the vermiform appendix and Fallopian tubes, may also cause obstruction. A portion of bowel may slip into an opening in the omentum or mesentery or the foramen of Winslow and become obstructed. In most of the above examples it is the small intestine that is involved (Fig. 131).

The strangulation may occur at the outset or after the bowel has been held for some time and venous congestion has resulted.

FIG. 131.



Constriction of gut by band; bone-plates in position.

What are the neoplastic causes of compression and obstruction from the outside of the bowel?

Solid or cystic growths of any kind, as of the liver, pancreas, ovary, uterus, and pelvic wall, etc., may compress the bowel.

What are the two clinical varieties of intestinal obstruction?

Based on *symptoms*, intestinal obstruction is divided into two kinds—acute and chronic. Occasionally the acute form may become chronic, but more commonly the chronic form becomes acute.

What are the symptoms of acute intestinal obstruction?

Severe abdominal pain, varying in character, like colic or as if a constricting band were drawn around the abdomen; *vomiting*, which may be "gastric," biliary, or faecal; *constipation*, absolute and insuperable from the first, or finally becoming so; abdominal distension, or *tympanites*, increasing with the illness (this symptom is sometimes not manifest until the abdomen has been opened); a varying degree of the condition of *collapse*.

What are the symptoms of chronic intestinal obstruction?

Flatulency; digestive disturbances; loss of flesh; depression of spirits; constipation becoming more and more intractable; pain, paroxysmal in character; more or less abdominal distension; vomiting, frequent and copious. All these symptoms tend gradually to increase in severity until they assume an acute form. When emaciation is marked the vermicular motions of the intestines may sometimes be observed through the abdominal wall.

Discuss the question of diagnosis of intestinal obstruction.

As between the *acute* and *chronic* varieties this is sufficiently clear, as already indicated by the symptoms. To complete the diagnosis it is necessary to establish as nearly as possible two points, *i. e.* *site* and *condition*, or *where* and *what* the obstruction is.

Discuss the question of site in acute intestinal obstruction.

SMALL INTESTINE.—If *vomiting* is an *early* symptom and is *non-feculent*; if *absolute constipation* is *not immediate*, but comes on *after* one or two movements of the bowels; and if the *tympanites* causes the abdomen to *bulge* more in the *centre* than on the sides,—it is practically certain that the obstruction is situated somewhere along the tract of the *small intestine*, and probably at some distance above the ileo-cæcal valve. *Occasionally* the abdominal pain may be sufficiently localized to help to indicate the probable site.

LARGE INTESTINE.—If *vomiting* is *late* and becomes *feculent*; if *absolute constipation* is *immediate* or comes on after only a very small movement of the bowels; and if the *tympanites* causes a *bilateral* and *transverse bulging* of the abdominal wall (*i. e.* along the course of the colon),—it is fairly clear that the site of the obstruction is well down in the course of the colon. In addition: if the *bulging* above mentioned *persists as such*—*i. e.* if *central bulging does not follow on*, and if there has been *one* fairly good-sized movement from the bowels *before* the onset of *complete constipation*, then the obstruction is probably situated at or near the *ileo-cæcal valve*. *Localized pain* in this region helps to confirm the diagnosis.

Discuss the actual cause of acute intestinal obstruction.

SMALL INTESTINE.—The diagnosis of acute obstruction in the small intestine having been settled, the *cause* is determined, approximately and in all probability, as follows: From experience, both clinical and from autopsies, we know that *acute intestinal obstruction* situated in the *small intestine* is due to one of certain

causes (each of which may have some characteristic points); and for similar reasons we know the same for *acute intestinal obstruction* situated in the *large intestine*. These causes (more than one of which may of course be acting in any given case) are tabulated:

		Causes.	Characteristic Points.
ACUTE IN- TESTINAL OBSTRUC- TION.	<i>Small intestine.</i>	Gall-stones.	Previous history of biliary colic, etc., indicating cholelithiasis.
		Volvulus.	Rare. Exclude all other especial causes.
		Intussuseep- tion.	Also quite rare. Exclude other causes. "Tumor" may be felt through abdominal wall. Pedunculated tumor may be present within lumen.
		Bands.	More common. Young adults with previous history of peritonitis.
		Apertures.	Exclude other causes.
	<i>Large intestine.</i>	Volvulus.	Comparatively common. More apt to occur in males over forty. Previous history of more or less constipation and of a possible sudden jar or fall. Sigmoid flexure.
		Intussuseep- tion.	More common in children. Tumor is often felt through the abdominal wall. Thin bloody diarrhoea and tenesmus very characteristic. Always examine rectum with finger, as the tumor may be felt, especially if the rectum is involved.

It is understood, of course, that an exact diagnosis, while advisable, is not always possible, nor is it absolutely necessary, because the treatment of acute intestinal obstruction, as such, is the same no matter what the cause may be—i. e. laparotomy, after which the exact cause is in the majority of cases made clear. Furthermore, if a case of chronic obstruction becomes acute, its cause must be reckoned as that of the acute case.

Discuss the questions of site and actual cause in chronic intestinal obstruction.

Site.—This point is determined in the same manner as that given in acute obstruction, but not so precisely, for the reason that the symptoms of chronic obstruction are not sufficiently clear and exact. Still, as a rule, in a case of chronic obstruction this method of determination is fairly accurate.

Cause.—For reasons the same as those given under Acute Obstruction we know that *chronic obstruction of the small intestine* is due to certain causes, and that *chronic obstruction of the large intestine* is due to other causes, all of which are given in the following table :

		Causes.	Characteristic Points.
CHRONIC IN- TESTINAL OBSTRUC- TION.	{ <i>Large intestine.</i>	Fæcal im- paction.	Usually in women past middle age. His- tory of constipation. A swelling along the course of the colon may be felt of doughy consistency. Vomiting may become feculent and the case becomes acute.
		Foreign bod- ies; enteroliths; pedunculated tumors (occur also in small intestine).	Nothing especially characteristic. A "tu- mor" is often felt. In case of a foreign body history of having swal- lowed one may be ob- tained.
		Cicatricial contraction of ulcers.	Previous history of dysentery, colitis, etc.

		Causes.	Characteristic Points.
CHRONIC IN- TESTINAL OBSTRUC- TION.	{	Tumors (in the wall of the gut; also in large intestine).	{ If malignant, general cachexia, palpable tumor, rapid course. Early onset of acute symptoms common. If benign, tumor may be felt.
		Intussusception.	{ Often a well-defined tumor is felt through the abdominal wall. More common than the acute. Often pedunculated tumor within lumen.
		Adhesions (also in large intestine, but much less common).	{ Previous history of enteritis or colitis, together with a mild succeeding peritonitis.
		Tumors (external to gut; also for large intestine).	{ Proper diagnosis of the tumor necessary.
		Cicatricial contraction of ulcers.	{ Previous history of typhoid fever.

From what conditions is intestinal obstruction to be diagnosed?

Suppurative peritonitis, appendicitis, strangulated hernia, localized paralysis of a portion of bowel (see next question), inflamed undescended testicle, lead-colic, hepatic and renal colic, dysentery, and cholera.

What is adynamic intestinal obstruction?

This is a condition of the intestines, due to *arrest of peristalsis*, which may cause symptoms identical with those of *acute intestinal obstruction*. A prominent symptom is extreme tympanites, due to the *extreme dilatation* of the intestines. There is no obstacle blocking the lumen. The muscular power of the intestines is lost, and passive dilatation follows. This condition is often due to peri-

tonitis or enteritis, or to a previous constriction, or to contusion of the abdomen, or to a laparotomy unduly prolonged. The *treatment* is on general principles. It may be admissible in some cases to perform *enterotomy* for the relief of the condition.

What is the treatment of acute intestinal obstruction?

The treatment adopted in a case of acute intestinal obstruction should be immediate. After preliminary observation, and when the nature of the case is made out, all cases readily group themselves into two classes:

The *first*, and by far the larger class, can only be saved by *abdominal section*. If this plan of treatment *be adopted as soon as a diagnosis has been made* and before peritoneal inflammation and distension of the abdomen have taken place, not waiting until the patient has become exhausted and his condition made hazardous by the administration of purgatives, *the chances of success are very great*.

In the *second* and smaller group of cases, consisting mostly of fecal impaction, the various palliative measures may be tried for a short time, but if unavailing operative interference is necessary.

What are the various forms of conservative treatment that have been recommended, and their value?

Enemata of warm water, oil, and other fluids, given by means of a syphon arrangement so as to regulate the pressure, have been used in the various forms of obstruction with some degree of success. Their greatest value is in *cases of fecal impaction*. A few cases of intussusception have been relieved by copious enemata, more especially invagination below the ileo-cæcal valve. This method of reduction should be practised with the greatest caution and gentleness.

What is the purpose of the operation of cœliotomy for the relief of acute intestinal obstruction?

It should be remembered that there are two important objects to be attained by the operation: (1) The relief of the distended bowel by the evacuation of its contents; (2) The removal of the constricting band or other cause of the obstruction and strangulation.

In a case of *impending death* from obstruction experience has shown that it is better to relieve the distension by *enterotomy first*, and to search for the cause of obstruction in a few days afterward, when the patient can bear it.

It may appear to be a somewhat unsurgical procedure or an incomplete operation to merely perform an enterotomy in a case where the cause of obstruction cannot be readily found; but the prime object of the operation is *to save life*, and in many cases it is not so much the mere presence of a constriction band or adhesion pressing on the bowel which is causing death, as it is the distension of the stomach and intestine above the point of obstruction by septic contents which are poisoning the system by reabsorption, etc.

Describe the operation in very urgent cases.

Many cases are seen so late by the surgeon that the patient has become exhausted, or his condition so hazardous from the previous administration of purgatives that nothing but the relief of the distended bowel by operation is permissible.

In these cases the administration of an anæsthetic is followed by alarming symptoms. The patient *rapidly becomes insensible*, there is a sudden rush of faecal matter from the mouth, and the patient *dies on the table*.

Local anæsthesia by the *hypodermic injection* of *cocaine* is all that is necessary. The patient is not in a condition to feel the pain from the knife.

Envelop him in warm blankets and surround his body with hot bottles. The operation may be performed without removing the patient from his bed.

Make the incision in the *median line*, below the umbilicus, about two inches in length, just large enough to allow the nearest distended coil of intestine to be grasped with the finger and drawn out through the wound. Do not stop to search for the cause of the obstruction, and so lose valuable time, but *rapidly fix* the *loop of bowel* in the peritoneal wound by sutures which do not penetrate beyond the submucous coat. The intestine may be evacuated by means of a trocar to which a piece of rubber tubing is attached, or by a large aspirating needle. The trocar is made to puncture the mucous coat after incising the outer coats with a scalpel. While the bowel is emptying itself it can be secured in the wound with additional sutures.

By effecting intestinal drainage in this way the patient may be tided over forty-eight hours, when the cause of the obstruction may be sought for and removed.

It is advisable to wash out the stomach, after the operation, with

a *hot borie-acid solution*. This revives the patient and adds to his comfort.

When the exhaustion of the patient is not extreme, a search may be made at once for the cause of obstruction; if easily found, and it consists merely of a band or adhesion, it may be divided without adding much to the danger of the operation.

Describe the operation in the less urgent cases.

In this class of cases the patient may be removed from his bed to the operating table. The stomach should be washed out with a hot borie-acid solution. The patient should be well protected from cold and all depressing influences guarded against. An anæsthetic should be administered, but *very cautiously* and *chiefly during the parietal incision*. Open the abdomen by a three-inch incision in the median line, in the usual manner, as hitherto described. Some surgeons advise a larger opening, but should it be found necessary the incision can afterward be enlarged.

On opening the abdomen the most distended coils of intestine will bulge forward into the wound.

The coils in the immediate vicinity should be inspected, very gently moved from side to side with the fingers, and the most distended coil sought for and followed in the direction of the increasing distension and congestion. This will almost certainly lead to the site of the stricture.

Should this method fail to disclose the obstruction, the most distended portion should be allowed to extrude from the wound and be protected by hot sponges or napkins. Careful inspection will reveal the direction in which it becomes increasingly distended and congested; the hand should then be introduced and made to follow the bowel along this portion until the obstruction is detected.

Various other methods of seeking for the point of obstruction have been recommended by different surgeons. Treves advises that a collapsed portion of gut should be traced to the site of obstruction. Another plan is to expose the intestinal tract, inch by inch, until the obstruction is found. Rand has advised an examination of the root of the mesentery by the "method of straightening the mesentery." In all procedures adopted the *distended intestine* must be *manipulated* with the *greatest care* in order to prevent *rupture*.

After the cause of the obstruction has been found and removed,

it may be advisable to *evacuate* the *distended* bowel. The opening made in the distended gut may be closed immediately after the bowel has emptied itself sufficiently, or it may be left open, forming a fecal fistula, to be closed at a *subsequent operation*.

In cases of *chronic obstruction* where the symptoms are not urgent a loop may be fixed in the abdominal wound with a view to subsequent opening at a later day. The bowel is not incised till after the lapse of forty-eight hours.

How are the various causes of obstruction removed in cases where cœliotomy has been performed?

Having found the cause of the obstruction, its treatment will depend upon the nature of the constriction. In most cases the removal of the cause will consist in the *division of a band* or *adhesion*; the *enlargement* of an *opening* or *aperture*, and the *consequent release* of the bowel; the *untwisting* of a *volvulus*; the *drawing out* of an *intussusception*; or the *removal* of a *foreign body*. In some it will be necessary to resect a *gangrenous portion* of intestine (enterectomy), or an *intestinal anastomosis* will be indicated.

Slender bands should be torn through, *larger ones* divided between two ligatures. A broad band should be *divided and tied in sections*. *Meckel's diverticulum*, if a still pervious tube, should have its divided ends closed by Lembert sutures and treated as a *divided intestine*.

In *strangulation through apertures* and *foramina* the bowel should be released by *traction*, and the opening closed when possible by sutures.

In a simple case of *volvulus* the *unravelling* of the intestine can be effected by manipulation.

In other cases the *untwisting* cannot be accomplished until after the *involved portion of bowel* is *tapped and emptied of its contents*.

Where *reduction* is *impossible* an *artificial anus* must be established. Resection of the affected portion of bowel is not to be recommended unless a portion of the intestinal wall has become *gangrenous*.

Senn advocates lateral anastomosis in cases of irreducible volvulus. *Recurrence* is prevented by shortening the mesentery by folding it upon itself, parallel to the long axis of the bowel.

In *intussusception*, if the abdomen is opened early, *before adhesions have formed*, the invagination can be easily reduced by the

surgeon drawing upon the *intussusciens* with one hand while he squeezes and kneads the *intussusceptum* with the other.

If the intussusception cannot be reduced after a fair trial, one of the four following plans may be adopted :

1. Lateral anastomosis by "short circuiting"—*i. e.* without resection.

2. Resection of the involved segment, with the formation of an artificial anus.

3. Resection of the involved segment, with immediate suture of the divided ends (circular enterorrhaphy). The objection to this procedure is that it would occupy a considerable period of time.

4. Enterotomy and the formation of an artificial anus without resection. This method is indicated where resection is contraindicated and time is pressing.

How are foreign bodies obstructing the bowel removed?

It will be possible in the case of some foreign bodies to break up their substance through the intact intestinal wall without opening its lumen. In case this can be done the foreign body should be pushed upward into a healthy part of the intestine.

If this method fails, then the intestinal wall should be incised in the longitudinal axis at its convex border and the obstruction removed.

If the bowel is ulcerated or gangrenous, a portion should be resected, with subsequent suture, or the formation of an artificial anus.

In other forms of obstruction, such as matting of many coils of intestine together by *adhesions*, and complex forms of *volvulus*, any of the procedures enumerated under the treatment of Intussusception may be instituted.

What is the mortality of operations for intestinal obstruction?

The results of operative interference in acute intestinal obstruction, according to Curtis, give a general death-rate of 69.9 per cent., while in cases not operated upon the mortality was 86.4 per cent. The highest death-rate was in cases where some form of intestinal suturing was made.

OPERATIONS ON THE LIVER AND GALL-BLADDER.

What surgico-anatomical points may be remembered in connection with the liver?

Extending below the subcostal angle is a portion of the surface of the liver which is covered only by the abdominal wall. This is the only area where the liver can be diagnosed by palpation and readily exposed for surgical operations. It forms a triangular space bounded above by the margin of the costal cartilages and below by a line extending from the *ninth right* to the *eighth left* costal cartilage.

What are the operations on the liver and gall-bladder?

1. For hydatid cyst ;
2. Hepatic abscess ;
3. Hepatotomy ;
4. Hepatorrhaphy ;
5. Cholecysto-lithotripsy ;
6. Cholecystotomy and cholecystostomy ;
7. Cholecystectomy ;
8. Cholecysto-enterostomy.

What are the symptoms of hydatids of the liver?

A large fluctuating tumor, distending the abdomen in the hepatic region, of slow growth, with pain, tenderness, and possible jaundice. The use of the aspirating needle will clear up the diagnosis.

What is the treatment for hydatids or echinococcus of the liver?

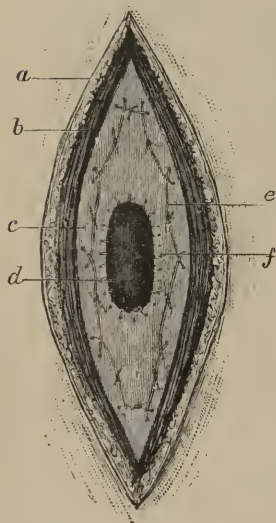
Aspiration and puncture by trocar have been used with some success, but the treatment by incision is to be preferred. This may be done in one or two stages.

Describe the operation by incision and evacuation of the hydatid cyst at one sitting.

Operation by One Stage.—Incision of the abdominal parietes over the most prominent part of the tumor; the *liver* is then *exposed*, and the field of operation surrounded with sponges or sterilized gauze; with the aspirating needle draw off the contents of the cyst so as to remove all tension. The needle-puncture is then

enlarged with a scalpel, and the lips of the cyst-wound are held against the edges of the abdominal wound until the whole contents of the cyst are evacuated. The margins of the cyst-wound are now sutured to the edges of the parietal wound, and a large drainage-tube or gauze packing is introduced. In some cases the liver-wound has been closed at once by suture (Fig. 132).

FIG. 132.



Method of attaching the liver to the parietes. *a*, Subcutaneous fat; *b*, rectus; *c*, sheath of rectus; *d*, liver; *e*, interrupted suture; *f*, continuous suture.

is closed, and evacuated in three to seven days when adhesions have formed.

What are the symptoms of abscess of the liver?

History of frequent attacks of illness, with rigors and elevation of temperature, furred tongue, rapid pulse, nausea, and vomiting. Locally there are pain and tenderness over the region of the liver, with fulness and bulging and occasionally fluctuation on palpation. The aspirating needle will settle the diagnosis.

What is the treatment?

Incision and drainage.

What is the after-treatment of the cyst?

Frequent washing out of the cyst-cavity with some antiseptic solution and the maintenance of perfect drainage.

What advantages are claimed for the operation by two stages?

It is claimed that this method prevents the danger of infecting the peritoneal cavity by the escape of blood or cyst-contents.

What are the steps of this operation?

Parietal incision and suture of the edges of the parietal peritoneum to the serous surface of the liver by a double row of catgut sutures. The wound is dressed, and the cyst of the liver is in-

Describe the operation.

Some surgeons recommend the operation by two stages, as for hydatid cyst. Or the liver may be opened at once, as follows:

Should exploration show the liver to be adherent to the parietes at any point, the opening should be made at that point. If there are no adhesions, the liver is brought into view, and flat sponges are packed around the point selected for making the opening. To relieve tension, part of the abscess-contents may be drawn off by means of the aspirating needle. As the knife is passed along the track of the needle into the abscess-cavity, follow it at once with the forefinger acting as a plug to prevent escape of pus into the peritoneal cavity. The forefinger is hooked into the abscess-cavity and coaptation of the edges of wounds of the liver to the abdominal wound is made. Secure and evert the lips of the abscess-wall by means of tenaculum forceps, which are held by an assistant, who keeps the liver-substance in contact with the parietes. Explore with finger for secondary abscesses; open these with finger or sinus forceps and thoroughly irrigate. Gently clean out the abscess-cavity with long-handled sponges. Pack the liver-wound and remove sponges and escaped fluid from the peritoneal cavity. Then stitch the whole length of the liver-incision to the parietal wound, and dress with an abundance of absorbent dressing, which should be changed at first once or twice daily.

What is hepatotomy?

This term is sometimes used to describe the incision through the liver-tissue for either hepatic abscess or hydatids. It may conveniently be adopted to describe operations in which a diseased portion of the liver is excised.

In what condition have portions of the liver been excised?

Experiments on animals and numerous operations on man have demonstrated that large portions of liver-substance containing tumors can be excised without undue disturbance of the functions of the liver. The operation has been successfully performed for the removal of hydatid cysts, gummatous growths, carcinomatous tumors, and portions of liver protruding from penetrating abdominal wounds.

What methods may be employed for dissecting out the diseased portions?

The thermo-cautery, the knife, or the scissors. In case of a

tumor with a broad base of attachment the "two-stage" operation should be performed. If a pedicle exists, it may be surrounded by an elastic ligature in the interval or delay between the stages.

What are the different methods of the after-treatment of the wound, and the means of arresting hemorrhage?

1. Suture of the lips of the wound in the liver and closure of abdominal wound.

2. Suture of the liver-wound to the edges of the abdominal wound and packing with gauze, and leaving it for treatment as an open wound.

What is hepatorrhaphy?

It is the term applied to suture or union of the liver-substance for wound or laceration. It may also be applied to the operation for fixation of a floating liver, as has been done by deep sutures passed through the right lobe of the liver and uniting it to the costal cartilages.

What is the anatomical position of the gall-bladder?

The gall-bladder lies in the fossa on the under surface of the liver. The fundus of the gall-bladder touches the abdominal parietes about opposite the *tenth right costal* cartilage.

What is the treatment of rupture of the gall-bladder and biliary ducts?

Rupture usually occurs as a complication of some other abdominal lesion. The treatment is cœliotomy and suture of the rent by uniting the serous surfaces. Should the tear be large or lie deep down, one of three procedures may be done:

1. Suture of the torn edges to the parietal wound, thus forming a *biliary fistula*.

2. Removal of the gall-bladder with and ligature of the cystic duct (cholecystectomy).

3. Cholecysto-enterostomy, or the formation of a fistulous opening between the rent already in the gall-bladder and a portion of intestine.

Rupture of the *common duct* has been successfully closed by suture. The torn portion has also been reimplanted in a portion of the intestine. Rupture of the *hepatic duct* can only be treated by establishing drainage through the abdominal wall.

What are the symptoms produced by gall-stones?

Frequently recurring attacks of "hepatic colic;" jaundice and ensuing cholaemia may occur, as also suppuration in the gall-bladder; obstruction in the cystic or common bile-duct: if in the latter, usually jaundice.

What is cholecysto-lithotripsy?

It consists of an exploratory cœliotomy, with the crushing of a calculus through the intact gall-bladder or cystic or common duct, either with the fingers or by means of forceps the blades of which are padded by being covered with pieces of rubber tubing.

What is cholecystotomy?

It is incision into the gall-bladder, followed by suture of the wound thus made.

In what conditions of the gall-bladder is the operation of cholecystotomy indicated?

In all cases of	$\left\{ \begin{array}{l} \text{Suppuration;} \\ \text{Dropsy or catarrhal inflammation} \\ \text{of the gall-bladder;} \\ \text{Cholelithiasis or gall-stones;} \end{array} \right.$	$\left\{ \begin{array}{l} \text{When other} \\ \text{treatment} \\ \text{has failed.} \end{array} \right.$
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Describe the operation of cholecystotomy, with subsequent suture of the bladder-incision, or the so-called "ideal cholecystotomy."

Incision of the parietes is directly over the fundus of the gall-bladder, four to five inches in length, in a vertical line, running parallel to the linea alba or obliquely and parallel to the borders of the ribs. After the peritoneum is opened the gall-bladder is examined with the finger. Pack flat sponges around the field of operation. If the cyst-wall is tense, draw off fluid contents with an aspirating needle. Catch up the cyst-wall with two pressure forceps as low down as possible, and open between them. Arrest hemorrhage. Gently draw the cyst into the parietal wound by means of the forceps; these are then held by an assistant.

Insert the finger through the opening in the gall-bladder and explore for calculi. These should be scooped out with a spoon or extracted with forceps. Stones impacted in the neck of the bladder or its duct must be chipped away in bits, while the forefinger outside the gall-bladder serves as a guide to prevent injury of the wall of the bladder. Stones impacted in the ducts may be crushed with padded forceps or broken into fragments with needles; remove

débris by irrigation. In some cases the common duct has been directly incised, the stones removed, and the wound closed by a double row of sutures. Now close the incision in bladder with a Czerny-Lembert suture, return to abdominal cavity, and close the abdominal wound.

This operation has been modified by including the line of suture of the gall-bladder in the abdominal suture, so that if a point of suture gives way the bile escapes outside, and not into the abdomen.

What are the dangers of this operation?

If a stone obstructing the common duct should be overlooked, escape of bile and peritonitis might result.

What are the indications for choosing the "ideal" operation?

• "Ideal cholecystotomy" should only be selected when there is no doubt of the permeability of the ductus communis choledochus, and that the walls of the gall-bladder are sound and healthy and that it contains only healthy bile. Otherwise *cholecystostomy* or "ordinary" cholecystotomy should be performed.

Describe the operation of ordinary cholecystotomy, i. e. with suturing of the edges of the opening to the parietal wound.

Perform cholecystotomy as just described, and remove the calculi. Then unite the edges of the opening in the gall-bladder with those of the abdominal wound by sutures passed successively through cyst-wall, parietal muscles, and skin. If extra sutures are needed to close parts of the parietal wound above and below the opening into the bladder, these should have been previously placed, but not tied till the last.

A drainage-tube or gauze packing is placed in the gall-bladder and the wound dressed with an absorbent dressing. The sutures are removed in seven days. The drainage-tube may be taken out at this time or left in longer. In this operation a biliary fistula is left, which will probably close of itself in a few weeks. If there still remain an obstruction in the common bile-duct, the fistula does not close and all the bile is discharged through the opening. In such a case the question of establishing a fistula between the gall-bladder and intestine should receive consideration.

What is the operation of cholecysto-enterostomy?

It is the formation of an opening between the gall-bladder and some portion of the intestine. In selecting the point where the

fistula shall be established the duodenum should be preferred; if this is not available, the *highest part* of the jejunum should be selected. The ileum and colon preferably should not be used. This operation has received different names, designed to indicate the portion of the intestinal tract selected for the fistula—*i. e.* cholecysto-duodenostomy, cholecysto-colostomy, etc. The details of the *operation of cholecysto-enterostomy* are essentially those of gastro-enterostomy.

What are the indications for the operation of cholecysto-enterostomy?

The establishment of a permanent fistula between the gall-bladder and some part of the intestine is indicated in *incurable obstruction* of the *ductus communis choledochus* from concretions, neoplasm, or cicatrices, and in cases of a persistent cysto-cutaneous fistula following cholecystotomy.

What is cholecystectomy?

The total extirpation of the gall-bladder, with ligature of its duct.

What are the indications for ablation of the gall-bladder?

1. In cases of malignant (growth) disease of the gall-bladder;
2. Ulceration and perforation of the gall-bladder with empyema, and when resulting loss of substance is too great to permit of cholecystostomy.
3. In dilatation of bladder with obliteration of the cystic duct.
4. In cases of calculi in which the gall-bladder is so contracted that it cannot, after opening, be sutured to the parietes.

What are the contraindications?

In cases of obliteration of the *ductus communis choledochus* the operation is contraindicated.

Describe the operation of cholecystectomy.

The operation is easily performed when the parts are normal, but may be very tedious and difficult after adhesions have formed. Abdominal section as above. Draw the edge of the liver upward and isolate area of operation with sponges. Divide peritoneal covering at the base of gall-bladder by two parallel incisions; the viscus is then bared and rapidly enucleated. Begin the separation at the fundus and proceed downward to the cystic duct; this is secured

between two ligatures and divided. Remove the bladder, unite divided edges of the peritoneum, and close the abdominal wound.

OPERATIONS ON THE SPLEEN AND PANCREAS.

What are the indications for splenectomy, or extirpation of the spleen?

Injury or prolapse, wandering or movable spleen, simple hypertrophy, and tumors, cysts, or hydatids. The removal of the spleen for leucocythæmic enlargement is generally considered unjustifiable.

What is the simple treatment of cysts and abscess of the spleen?

Incision and drainage. The details of the operation are the same as have already been described for similar conditions in the liver.

What are the symptoms of wounds and injuries of the spleen?

Wound and hemorrhage can only be inferred from the site of the injury and the general symptoms. Later on, peritonitis or abscess may develop. Wound should be treated by abdominal section and suture; if very extensive, splenectomy is called for.

What are the dangers from movable spleen?

The organ may become prolapsed, the pedicle twisted, and gangrene result.

Describe the operation of splenectomy.

Incision along the outer border of the left rectus or in the median line. In wound or prolapse the original opening may be enlarged. If adhesions exist, they are divided with or without ligation. They may be so extensive as to make the abandonment of the operation advisable. The most important part of the operation is the treatment of the pedicle. Severe dragging on the pedicle is to be avoided. Each vein and artery to be divided should be separately ligated. All the vessels of the pedicle may be temporarily secured with pressure forceps and afterward tied after removal of the tumor. If the pedicle is long, it may be secured with a large clamp before the vessels are ligated. It is safer to err in applying too many ligatures than to attempt to include the whole pedicle in two or more. Finally, the ligatures are all cut short, the stump dropped back in the abdominal cavity, and the wound closed. The mortality of these operations for other conditions than leucocythæmia is about 17 to 18 per cent.

What is the surgical position of the pancreas ?

It lies deeply in the abdominal cavity, and can only be reached by division of the gastro-colic omentum and by pulling the colon and stomach apart.

What operations have been performed on the pancreas ?

Extirpation of the pancreas has invariably been followed by a fatal result. Partial excision of the splenic portion has successfully been accomplished in cases of malignant disease. The treatment of simple or hydatid cysts or suppuration, in connection with this organ, by free incision, followed by suture of the sac to the abdominal wall and drainage of the cavity, has given excellent results.

What are the causes of the formation of cysts ?

Retention of pancreatic fluid from arrest of absorption of the pancreatic juice and obstructions of the duct, and the echinococcus.

What are the symptoms ?

Tumor in the epigastrium, with previous history of inflammation in this region: colicky pains, fatty stools, impaired digestion. By aspiration in a case reported by Bull, the fluid was dark brown, turbid, odorless, and became solid on boiling.

What diseases occur in connection with the omentum ?

The omentum may be the seat of solid (usually malignant) or cystic tumors. Cysts are simple or due to the echinococcus.

What are the symptoms of omental tumors ?

Pain, ascites, intestinal obstruction, subacute peritonitis. The presence of a tumor is detected by palpation.

What is the treatment ?

Abdominal section with enucleation and removal of solid tumors and removal or evacuation and drainage of cystic growths.

(For diseases of, and operations on, the *kidneys*, *ureter*, and *bladder*, see volume on GENITO-URINARY AND VENEREAL DISEASES of this series; and for similar subjects on the *uterus*, *tubes*, and *ovaries*, see GYNECOLOGY of this series.

HERNIA.

Define the term "hernia."

The protrusion of any portion of the abdominal or pelvic contents through an opening in the parietes, which opening may be either abnormal or one of the regular openings of the muscular layer abnormally enlarged, and which does not involve the skin.

The term is also used to denote the protrusion of any viscus from its natural cavity, as hernia cerebri.

Mention the causes of hernia.

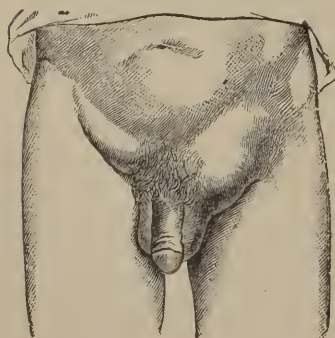
Predisposing Causes.—Weakening of the abdominal wall by the passage of some normal structure, as the spermatic cord, femoral vessels, or by an old cicatrix; a long mesentery; congenital defects of the parietes; relaxed muscular tissue; bronchial disease, urethral stricture, and constipation predispose by causing constant straining.

Exciting Causes are—great muscular exertion, such as occur in lifting heavy weights; severe contraction of the abdominal muscles to overcome constipation and effects of urethral stricture.

Mention the ordinary sites of herniæ.

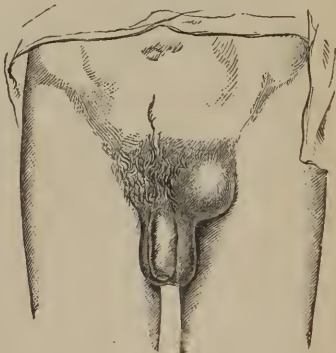
Inguinal and femoral canals, umbilicus, and in cicatrices of abdominal wounds; herniæ at the obturator and sciatic foramen and through the diaphragm are rare (Figs. 133, 134, 135, 136, 137, and 138).

FIG. 133.



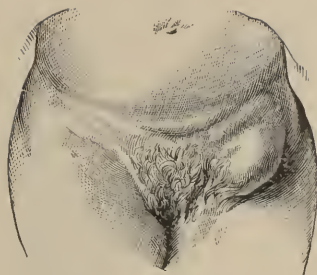
Oblique Inguinal Hernia (Bryant).

FIG. 134.



Direct Inguinal Hernia (Bryant).

FIG. 135.

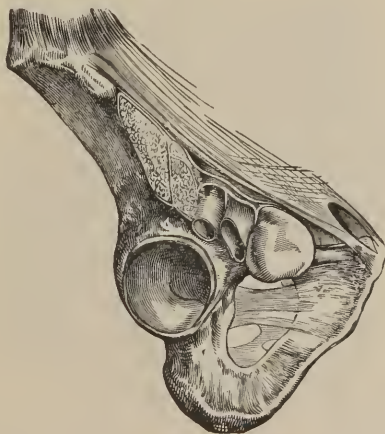


Femoral Hernia (Bryant).

What are the ordinary coverings of a hernial tumor?

The *parietal peritoneum* is usually pushed before the protrusion, stretched and enlarged by interstitial growth, so as to form the *sac* of the hernia. Outside of the sac are found the various fasciæ, muscular structures, superficial fascia, and skin of the region in which the hernia occurs.

FIG. 136.



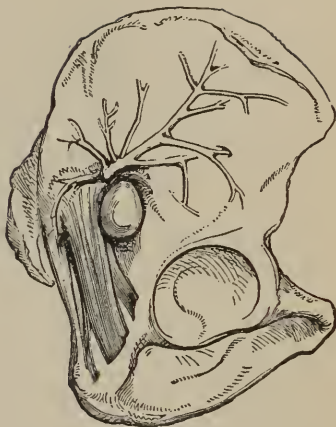
Femoral Hernia, and its relations to other parts beneath Poupart's ligament (King's Coll. Mus.).

FIG. 137.



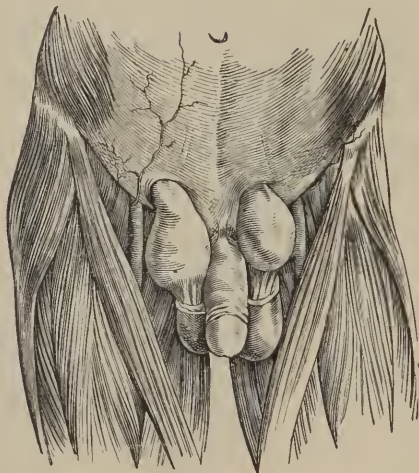
Obturator Hernia.

FIG. 138.



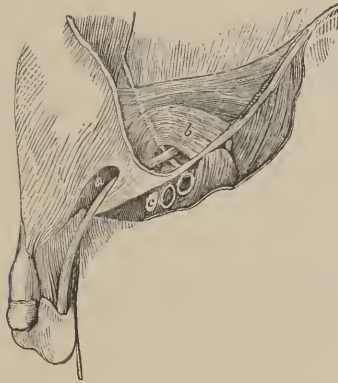
Sciatic Hernia.

FIG. 139.



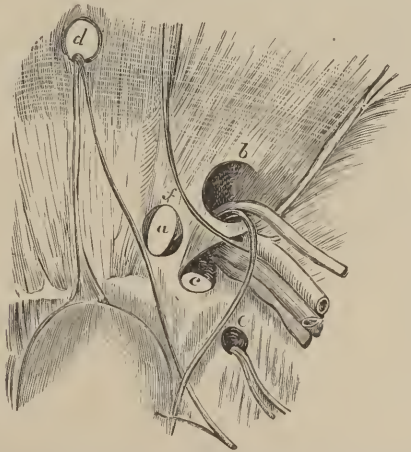
Oblique Inguinal Hernia on the right side, direct on the left.

FIG. 140.



The Inguinal Region from the Front: *a*, superficial ring; *b*, the fibres of the internal oblique normally covering the deep ring, and restraining protrusion; *c*, crural ring. The lower fibres of the *transversalis abdominis* muscle and the epigastric artery, lying behind the fascia transversalis and crossed by the cord, are also shown

FIG. 141.



Diagrammatic *Internal View* of the enlarged openings and parts concerned in the formation of inguinal, crural, umbilical, and obturator hernia: *a*, the superficial ring seen through the opening at which *direct* hernia protrudes (the obliterated hypogastric should be *external* to this); *b*, the deep ring through which the *oblique* hernia passes; *c*, the crural ring; *d*, the umbilical ring; *e*, the obturator opening; *f*, the epigastric artery.

What are the anatomical varieties of inguinal hernia?

(1) As to the *position* of the sac: If the *neck*—*i. e.* the portion connecting the main part or *body* of the sac with the general peritoneal cavity—is situated *in* the internal abdominal ring, the hernia is an *oblique* inguinal hernia or an “external” inguinal hernia, because the neck is *external* to the deep epigastric artery. If the *neck*, on the other hand, is surrounded by the fibres of the *conjoined tendon* immediately posterior to the external abdominal ring, the hernia is *direct* or “internal” (internal to the deep epigastric artery).

(2) As to the *condition* of the sac: These varieties are subdivisions of *oblique* inguinal hernia, and each is dependent upon the condition of the funicular process or *tube* of peritoneum which accompanies the testicle in its descent. Thus:

“Normal.”	{ The original process or tube of peritoneum is entirely obliterated, and the <i>sac</i> is a new pathological process or tube, and has no communication with the tunica vaginalis testis.
Congenital.	{ There is <i>no obliteration</i> of the original peritoneal tube, and the “sac” extends from the surface of the testicle right into the general peritoneal cavity. There is no tunica vaginalis testis (Fig. 142).
Infantile.	{ There is <i>partial obliteration</i> of the original peritoneal tube, usually <i>at</i> the internal ring. In this case the tunica vaginalis testis may be said to extend from the surface of the testicle up to the <i>septum</i> at the internal ring. The hernia <i>invaginates</i> this septum <i>into</i> the abnormally large “tunica” (Figs. 143 and 144).

FIG. 142.



Diagram of Congenital Hernia (Bryant).

FIG. 143.



Before the Occurrence of a Hernia.

FIG. 144.



After the Occurrence of a Hernia.

What terms may be used to describe a hernia?

When consisting entirely of intestines the hernia is called an enterocoele; when consisting of omentum, an epiplocele.

The operative treatment of omental hernia is the same as for intestinal, except that the redundant omentum is ligated in several places as high up as possible, cut off below the ligatures, and removed.

Define the terms used to describe certain clinical conditions of a hernia.

When a hernia can be pushed back into the abdomen, it is called "reducible." When it cannot be reduced by manipulation, it is "irreducible." Sometimes this condition is denoted by the term "incarcerated." In a "strangulated" hernia the protruded parts are so firmly grasped that they cannot be reduced, and the circulation is impeded so that congestion, inflammation, or gangrene may occur or are actually present.

If, when a hernia has been reduced by taxis (manipulation), the *sac* has also been pushed back (not a common occurrence), this event is called "*reduction en masse*" (Fig. 145 A).

In congenital inguinal hernia there is sometimes a *diverticulum* from the main sac, usually extending upward between or behind the abdominal muscles. Should the hernia, by taxis, be pushed into this diverticulum, the result is called "*reduction en bissac*" (Fig. 145 B).

FIG. 145.



A, Reduction en masse; B, Reduction en bissac.

FIG. 146.



Littre's hernia.

What is Littre's hernia?

A variety of femoral hernia (almost invariably) in which only a *portion of the circumference* of the intestine is caught (Fig. 146).

Describe the symptoms of a reducible inguinal or femoral hernia.

A fulness or swelling, which becomes marked when the patient stands, occurs at the seat of the hernia. The tumor is smooth and uniform, and disappears when the patient lies down, or it may be reduced by *taxis*. Coughing causes an impulse in the tumor. The tip of the finger may be placed in the ring through which the hernia disappears, and if held there prevents the hernia from returning. If the contents be bowel, the tumor gives a tympanitic percussion note; if its contents be omentum, the note is dull and it will have a doughy feel. There is usually a feeling of weakness and sometimes griping pain at the site of the hernia. Femoral hernia is *below* and *external* to the SPINE OF THE PUBES, while inguinal hernia is *above* and *internal* to the same.

What is the palliative treatment of hernia?

Provide a compress of gauze or a truss which will keep the hernia within the abdomen. A truss consists of a pad to fit over the site of the hernia and a belt or spring which surrounds the body and keeps the pad in place. The truss should be worn all day and taken off at night after going to bed, and put on in the morning before rising.

Describe the operative treatment (herniotomy) of reducible inguinal hernia.

The principle of all modern operations for the radical cure of inguinal hernia consists in the obliteration of the sac and the closing of the ring by sutures. Many operations have been devised to effect this purpose. The simplest is that of Banks for inguinal hernia. An incision is made over the tumor. The *sac* is separated from the cord and surrounding structures and opened. The hernia is then reduced. The sac is now sutured and ligated close to the parietal peritoneum and cut off. The ring is then closed by suturing as far down as the cord and the abdominal wound closed.

The method of Halstead is as follows: Make the skin incision from a point 2 cm. internal to the anterior superior spine of the ilium to the spine of the pubes. Divide the subcutaneous tissues so as to expose the aponeurosis of the external oblique, the external abdominal ring, and the sac of the hernia. Then sever the aponeurosis of the external oblique muscle, the internal oblique and transversalis muscles, and the transversalis fascia to the extent of the skin incision. Then open the sac to admit two fingers, reduce

its contents back into the abdomen, hold it tense, and strip it from the tissues in which it is imbedded. After the division of the above structures the constricted part, or so-called "neck," of the sac disappears. The sac having been isolated, the opening in it is now incised for the length of the wound, and the peritoneal cavity thus opened is closed as deeply as possible by seven or eight quilted sutures of silk. Cut away the redundant peritoneum close to the peritoneal sutures. Isolate the vas deferens and its vessels, and *beneath it* suture together the cut edges of the transversalis and internal oblique muscles and the aponeurosis of the external oblique muscle. *Over* the vas deferens now close the skin incision and apply the usual dressing.

The same principles as in Banks's operation apply to *femoral* hernia, except that the femoral ring cannot always be closed.

What is the treatment of irreducible hernia?

The herniotomy offers a satisfactory method of reduction. The operation is usually more difficult than in reducible hernia, because the sac may contain a large amount of omentum which is adherent. The excess of omentum should be tied off. When operation is refused, the hernia should be protected by a truss with a large concave pad.

What are the symptoms of strangulated inguinal or femoral hernia?

Locally, there is a tumor, inguinal or femoral, which is *painful, tender, tense, tympanitic* or "*dull*," *irreducible*, and with, sometimes, *redness of the skin*. *Together with* these are the symptoms of *acute intestinal obstruction*, of which, of course, strangulated *intestinal* hernia is only a special variety.

What is the treatment of strangulated inguinal or femoral hernia?

If the above symptoms have existed for a number of hours, herniotomy is *immediately* indicated. If they are of sudden and recent occurrence, the *actual condition* of the intestine may be such that its return to the abdominal cavity without operation might be followed by recovery. Hence in such cases, before proceeding to herniotomy, treat as follows: Give morphine gr. $\frac{1}{4}$ hypodermically, and place the patient in a hot bath, with legs flexed on the abdomen. At the end of half an hour try taxis *gently* and for a *few minutes only*. Should reduction not follow, give ether at once, and after complete anæsthesia is effected try taxis again. Should this

fail after five minutes' trial, then proceed at once to perform *herniotomy*.

What is taxis?

By taxis is meant the reduction of the hernia by manipulation with the fingers. In performing taxis place the patient fully under the influence of ether, after having obtained his consent to an operation. Raise the pelvis, and (in femoral hernia also) flex and rotate the thigh inward. With the fingers of one hand grasp the neck of the tumor near the ring, while with the other seize the tumor, gently raise it, and draw it slightly downward. Then by means of pressure endeavor to push or squeeze the gut into the abdomen. The direction of the pressure differs for the different forms of hernia. In femoral hernia the pressure is directed downward, then upward and inward. For inguinal hernia it is slightly upward and outward. Success is indicated by the hernia returning to the abdomen with a sudden rush or "gurgle." Prolonged or violent manipulation should be avoided.

In what condition may the symptoms of strangulation still persist after reduction?

1. In reduction of gangrenous bowel; 2. Paralysis of the bowel from peritonitis; 3. When a second strangulated hernia exists; 4. Reduction *en masse*.

Describe herniotomy for strangulated inguinal or femoral hernia.

Up to and including the *opening of the sac*, the steps are the same as in Banks's operation, already described. After opening the sac the *constriction should be cut*. The condition of the bowel is now the point to be considered. If it is not gangrenous, it may be returned and the operation completed as for reducible hernia. If *gangrene is present*, see following table:

Treatment.

If patient's general condition is good,	{ resection of gangrenous portion; circular enterorrhaphy.
If patient's general condition is poor.	{ resection with formation of artificial anus, both ends of intestine being placed in the wound.
If patient's general condition is very poor,	{ simple "anchoring" of gangrenous part in the wound by sutures through healthy gut above and below. Wound packed and gangrenous part allowed to separate spontaneously.

Describe the three forms of umbilical hernia.

Congenital umbilical hernia is due to an arrest of development of the abdominal wall, so that a large or small tumor forms at the root of the umbilical cord.

Infantile umbilical hernia is caused by a stretching of the umbilical cicatrix after separation of the cord.

Adult umbilical hernia occurs in later life, most frequently in stout women who have borne many children. It may attain to a large size.

What is the treatment?

When reducible, a well-fitting truss. For the "strangulated" form taxis, and, if this fails, operation, on the lines already laid down for preceding varieties.

How does ventral hernia form?

It occurs at any part of the abdominal wall, usually at the site of an old cicatrix or after an injury or abscess of the abdominal wall. The treatment is either a truss or operation. Lumbar, perineal, ischiatic, and obturator hernia are rare. Diaphragmatic hernia may be congenital or traumatic. It is rarely recognized till after death.

What is properitoneal hernia?

In this form of hernia the protrusion occupies an abnormal site in the abdominal or pelvic wall, in front of the parietal peritoneum.

In case of strangulation the proper treatment is free incision and operation for its radical cure. It may be reduced from within after abdominal section.

APPENDICITIS.

What is appendicitis?

Appendicitis is inflammation of the vermiform appendix.

What are the varieties of appendicitis?

Catarrhal, suppurative, and gangrenous. The former may be limited to the mucous membrane alone or involve all the coats, in which case the peritoneal surface of the appendix is also implicated and is the seat of a sero-fibrinous peritonitis. The remaining varieties always involve all the coats.

Discuss the question of adhesions with appendicitis.

Each one of the above-mentioned varieties of appendicitis *may* or *may not* involve the surrounding peritoneum; that is, it may or may not cause a *fibrinous peritonitis* of the surfaces of the *neighboring coils of intestine*. This fibrinous peritonitis, when produced, causes the *formation of adhesions* between the surfaces of these in-

testines and of the parietal peritoneum, thus shutting off the appendix in a sort of cavity. Furthermore, in suppurative or gangrenous appendicitis the process is so severe that *perforations in the appendix* are apt to occur, and generally do if the inflammation is allowed to run its course. The following table shows briefly the various conditions which may occur under each variety of appendicitis.

Without the formation of adhesions.	Catarrhal appendicitis.	Remains as such; perforation never occurs or <i>very seldom</i> , and then only when a foreign body is within the lumen and ulcerates through.
	Suppurative appendicitis.	(a) Remains as such (rare); (b) <i>perforation occurs</i> and sets up a more or less general suppurative peritonitis; (c) a more or less general suppurative peritonitis is set up <i>without perforation</i> occurring.
	Gangrenous appendicitis.	Remains as such (rare); causes a more or less general suppurative peritonitis either <i>with</i> or <i>without perforation</i> .
With the formation of adhesions.	Catarrhal appendicitis.	Just as in the above, except the appendix is surrounded and matted in with adherent intestines.
	Suppurative appendicitis.	There is formed around the appendix a cavity whose wall consists of coils of matted intestine, together with, usually, the nearest portion of parietal peritoneum also. Within this cavity is pus derived from the suppurating appendix (abscess) which lies in the midst, and in which there <i>may</i> or <i>may not</i> be a <i>perforation</i> .
	Gangrenous appendicitis.	<i>Just as in the above, except</i> , instead of pus, there is a hemorrhagic effusion and the appendix is <i>gangrenous</i> , and, in like manner, may be <i>with</i> or <i>without</i> a <i>perforation</i> .

In some cases there is often found a combination of gangrenous and suppurative appendicitis. Furthermore, even when adhesions are formed they may break down and the contents of the cavity, suppurative or hemorrhagic or both, as the case may be, thus escape into the general peritoneal space and lights up a corresponding general peritonitis. The presence of adhesions is inferred clinically by feeling a swelling through the abdominal walls in the region of the appendix. Failure to feel this swelling does not imply absence of adhesions.

What are the causes of appendicitis?

Of the *catarrhal* variety: foreign bodies, fecal concretions, extension from varieties of colitis, undigested food, etc.

Of the *suppurative* and *gangrenous* varieties: A preceding catarrhal appendicitis or any one of its causes direct; traumatism; or the process may be "idiopathic," just like any other inflammation, as abscess in the neck, etc.

Discuss the clinical aspect of appendicitis.

From the point of view of *symptoms* there are but two kinds of appendicitis—*mild* cases and *severe* cases. The former when operated upon are almost always found to be catarrhal; hence we assume all mild cases to be of this nature. The severe cases are of course suppurative or gangrenous, or a combination of both. However, this is not always true, for severe cases are sometimes found to be catarrhal, and *very* rarely mild cases to be suppurative or gangrenous. No clinical difference can be made between suppurative and gangrenous appendicitis.

What are the symptoms of appendicitis?

Simply a detailed list of these would be of little use, for they vary greatly—more so perhaps than any one other disease. They will be discussed below together with *treatment*. Suffice it here to say that the symptoms are both general and local, the former being those of *septicæmia* in one or other of its grades of severity, while the *latter* are abdominal *pain* and *tenderness* and the *presence of a tumor*. All cases occur *very suddenly*. The pain and tenderness may be both general and *local*, but the *latter* are much more marked, and are referred to the right iliac region. A point of extreme tenderness (McBurney) is often made out by pressure with one finger along a line from the anterior superior spine to the umbilicus. A tumor or swelling is often felt in the right iliac region.

Discuss the treatment of appendicitis.

The indications are really so numerous and varied that no precise rules can be given. An approximation is all that can be attempted. A few types of cases will be taken as follows :

1. Cases in which the *local pain* is severe and the *local tenderness* may be extreme ; in which there is some diarrhœa, together with a pulse and respiration a little above the normal, and a temperature of 100° – 101° F., and with a pretty clear tongue,—are considered to have a fairly severe form of catarrhal appendicitis and require conservative treatment, but the most careful watching, as they may, at any moment almost, develop severer symptoms. Remaining as such, these cases should become decidedly better within three or four days.

2. Cases in which the local pain and tenderness are severe, and a *swelling* is made out in the right iliac region, with vomiting and constipation ; a temperature of 101° – 102° F. ; pulse 120 and a coated tongue ; and in which all these symptoms have come on *within twenty-four hours*, may be considered as a possibly severe form of catarrhal appendicitis, and thus *may* receive conservative treatment. (Some authorities advise immediate operation, regarding them as cases of suppuration.) Should the case, however, be worse, or even *no better*, at the *end of thirty-six hours* after the onset of the symptoms, it is practically certain to be one of suppurative appendicitis, and requires operative treatment without further delay. A case presenting the same symptoms, but seen first only after a lapse of thirty-six hours, requires immediate operation. Should such a case be better on the second day—*i. e.* pain and tenderness less, pulse and temperature diminished—conservative treatment may be continued.

The presence of a swelling is not *essential*, but only confirmatory. Its absence alone would not contraindicate an operation, because it might mean either simply failure to detect or absence of adhesions. This statement applies to all varieties of appendicitis.

3. Cases presenting all the symptoms of those of No. 2, but still more severe, such as a chill, temperature over 102° F., pulse over 120, with some delirium or apathy, require operative treatment at once, no matter how short a time these symptoms have existed.

4. Should a case presenting all the symptoms of No. 2 suddenly “feel better” after about thirty-six hours, with the swelling, pain, and tenderness diminished, but with still a high temperature and rapid pulse, an *immediate* operation is required, for the reason that

this "improvement" is due to the giving way of some of the adhesions, with consequent diminishing of the tension. This condition is very dangerous, for at any moment the exudate may break out into the general peritoneal cavity, and set up general suppurative peritonitis—an almost fatal complication.

5. Should a case of appendicitis be seen with a history of having had, except the swelling, all the symptoms of No. 2 or No. 3, but whose present condition, of sudden occurrence, shows absence of swelling, pain, and tenderness; with diminished temperature and a high pulse; with somewhat cold skin and a drawn, anxious facies,—the inference is that a *perforation* has occurred, and that there had been no limiting adhesions. Hence general peritonitis is imminent and operation urgent. Such a condition, which is simply a form of collapse, may also be due to the breaking down of adhesions and consequent escape of pent-up exudate. Immediate operation is equally indicated. Perforation of the appendix occurring when the latter is well walled in with adhesions does not seem to cause any symptoms of collapse.

6. Cases seen in *extreme* collapse are practically hopeless. There is usually perforation and a gangrenous appendix. Death is certain without an operation, and almost certain with one.

What is meant by recurring and relapsing appendicitis?

Recurring Appendicitis.—This means cases of catarrhal appendicitis which get well without operation, but which tend to recur at varying intervals. A *swelling* is almost always felt, especially during an attack. Numerous recurrences may take place. The treatment is conservative, but as each attack is liable to become suppurative, and as such "secondary" suppuration, on account of the quantity of adhesions, is the more difficult to operate upon the more numerous the preceding catarrhal attacks, an operation is advisable *between these attacks*.

Relapsing Appendicitis.—This is precisely similar to the above, except that the patient never gets entirely well. It is really chronic catarrhal appendicitis. Between the attacks the patient has pain and discomfort over the appendix, irregularity of the bowels, and feels generally miserable. Operation between relapses is strongly indicated (Bull).

What is the conservative treatment of appendicitis?

Absolute rest; saline purgatives or enemata for cases in No. 1,

but *not* for those in No. 2; fluid diet; hot fomentations locally or an ice-coil; morphine very sparingly.

What is the operative treatment?

Abdominal section and removal of the appendix. When performed in cases such as are given under No. 2 or in recurring or relapsing appendicitis the prognosis is favorable.

Describe the operation.

Make a five-inch incision from the level of the umbilicus in the right linea semilunaris, or a similar incision nearer the anterior superior spine of the ilium, and more obliquely placed. Divide the peritoneum at the upper part of the wound, as adhesions are less liable here to be encountered. The small intestine is now pressed toward the median line, and the cæcum appears in the wound. This is turned outward, and the appendix either becomes visible or is felt for with the finger. If no adhesions are encountered, the appendix should be raised, and an aneurism needle armed with a double ligature passed through its mesentery close to its base. The ligature is divided at its loop, and one portion is tied about the mesentery, and the other around the appendix one-fourth of an inch from its junction with the cæcum. The appendix is then cut from its mesentery, and then divided just beyond the ligature. The mucous membrane in the stump should be destroyed with the Paquelin cautery, or the method of turning in and suturing the opposing serous surfaces may be used.

Should adhesions have formed, they should be gently separated by blunt dissection in the direction of the appendix. A valuable guide to its location is the longitudinal bundle of muscular fibres on the anterior surface of the cæcum which terminates interiorly at the appendix. In separating adherent coils of intestines the operator should proceed as if an abscess existed, and a gush of pus may be encountered at any moment. The field of operation should be walled off from the rest of the abdominal cavity by sponges or gauze compresses. If pus is found, it should be caught on long-handled sponges and thoroughly wiped away before proceeding to the removal of the appendix.

When the appendix is in a large abscess-cavity and has been destroyed so that it cannot be removed, the operation reduces itself to the opening of the abscess. If a great deal of pus is present, a counter-opening may be made in the flank just above the crest of the

ilium, through which a drainage-tube is passed, in addition to packing the diseased area with iodoform gauze.

In a case where no pus has been found the abdominal wound is closed without drainage.

What is perityphlitis?

This is inflammation of the cellular tissue *around* the cæcum. If, as sometimes happens, the appendix is placed *behind* the cæcum, and thus has little or no peritoneal covering, it is also involved in this inflammation, which is usually suppurative. The symptoms resemble those of appendicitis, and in addition there are redness and visible swelling in the neighborhood of the right anterior superior iliac spine.

Treatment is by incision parallel to Poupart's ligament, irrigation, and packing the abscess-cavity with iodoform gauze. "Perityphlitic abscess" is a synonym for this affection.

PERITONITIS.

What are the varieties of peritonitis?

Only those will be mentioned which have surgical interest. They comprise the following:

Non-specific.	Suppurative.	<ul style="list-style-type: none"> { 1. Diffuse or general; { 2. Progressive focal; { 3. Local.
	Fibrinous.	<ul style="list-style-type: none"> { To this are due the various <i>ad-</i> { <i>hesions</i> that form. It may be { local or general, and in either { case it may be <i>primary</i> or as ac- { companying a corresponding <i>sup-</i> { <i>purative</i> peritonitis.
	Serous.	<ul style="list-style-type: none"> { This is "ascites," which often { accompanies cirrhosis of the liver, { etc.; when excessive, tapping in { the median line is indicated.
Specific.	Tubercular.	<ul style="list-style-type: none"> { Peritoneum studded with mil- { iary tubercles; serum in the { cavity.

Discuss suppurative peritonitis.

THE LOCAL VARIETIES.—The best example is *suppurative appendicitis*, already described. A similar *local* peritonitis may occur

anywhere. The lesions are the same: adhesions form, pus collects in the midst, the "walls" are coils of intestine, and *perforation* of the organ *primarily involved* may or may not occur. This "primary involvement" may mean an ulcer of the stomach or of the intestines resulting from inflammation or traumatism acting on the mucous membrane, or salpingitis, etc. *Diagnosis* is based on previous history and on any indications of local pain, tenderness, and swelling. Other symptoms resemble those of the following:

PROGRESSIVE FOCAL.—Various foci of pus, each walled in by adhesions between coils of intestine, develop one after another. *Causes.*—The same as in the preceding variety. *Symptoms.*—Similar to the following:

DIFFUSE OR GENERAL.—Generally excited by penetrating wounds of the abdomen or by perforation of a viscus due to previous inflammation, traumatism, or malignant growth. Cases have occurred, however, in which failure to find such perforation is recorded. But there is really no more reason to argue against "idiopathic" general suppurative peritonitis than there is against "idiopathic" suppurative inflammation anywhere.

Symptoms.—Marked septicæmia; rigidity and swelling of abdominal wall; legs drawn up; abdominal pain and tenderness severe; palpation may give fluctuation or dullness; if the latter, it is more in favor of progressive focal peritonitis; marked tympanitic resonance, especially if it hides liver-dullness, indicates gas, and hence perforation of the alimentary canal. The *fever* and *tenderness* are points in differential diagnosis from acute intestinal obstruction, which, when *uncomplicated*, presents *no fever*, and in which *deep pressure*, if made gently, often relieves the colicky pain; while even the lightest touch is often unendurable in peritonitis, whether local or general or "focal."

What is the treatment of suppurative peritonitis?

The *local* varieties should each be treated as nearly as possible according to the rules laid down under *Appendicitis*. In the other varieties abdominal section and drainage are indicated. If "focal," the incision should be made, if possible, over the focus, whose site may be judged from an area of dullness. In the *general* form the incision is in the median line and below the umbilicus. Flushing or washing out the general cavity is questionable. Good results have been obtained from simply *wiping* the cavity and intestines with gauze. In all cases of perforation suture should be applied.

What is the treatment of tubercular peritonitis?

Abdominal section, evacuation of the fluid, and closure of the abdominal wound without irrigation or drainage seem to exercise practically a *cure* effect in cases of purely peritoneal origin, and to have a decidedly ameliorative effect even in cases in which the lungs or other organs are involved.

WOUNDS OF THE ABDOMEN.

Give the varieties of wounds of the abdomen.

Essentially they are the same as wounds in general. Each may penetrate the abdominal cavity or not, may or may not involve an organ, and finally may or may not be complicated by protrusion through it of an organ which may itself be wounded or otherwise. Thus we have the following table :

Wounds of the abdomen.	{	Penetrating.	{	Viscera not wound-	{	With protrusion.
				ed.		Without protrusion.
		Non-penetrating.	{	Viscera wounded.	{	With protrusion.
						Without protrusion.

Discuss the diagnosis between penetrating wounds with viscera not wounded and non-penetrating wounds.

With Protrusion.—The diagnosis is of course self-evident.

Without Protrusion.—This question, considered *without regard to perforation* (to be discussed later) of the abdominal cavity, depends on whether the wound is *large* or *small*; if the latter, the *condition of the patient* must also be determined.

IN LARGE WOUNDS.—In these, whether they be incised, lacerated, or punctured, it is comparatively easy by direct examination to find out the *state of the peritoneum*. If this is *untouched*, the wound is “non-penetrating,” and requires simply ordinary wound treatment. On the other hand, *if the peritoneum is found to be severed*, the wound is “penetrating,” and, in the absence of *visceral wounds* (to be discussed later), should be sutured at once or after return of the viscera to the abdominal cavity if there is protrusion.

The presence or absence of internal hemorrhage is settled by direct inspection through the wound.

IN SMALL WOUNDS.—The far most common varieties are bullet-(pistol-shot) and stab-wounds. In these the *condition of the wound*, pure and simple, offers no points on which to base a diagnosis, because there is no way of inspecting the peritoneum without enlarging the wound (which should *never* be done, nor should it be even probed *merely for purposes of diagnosis*). Nor is there any protrusion, because the wound is too small. Even the character of the *hemorrhage*, from purely the wound point of view, is not decisive, because it is known that many non-penetrating wounds bleed profusely, and that penetrating wounds may not, and *vice versa*. Hence in *small wounds* of the abdomen we must also consider the *condition of the patient*. For example: A pistol-shot wound of the abdomen is considered to be *non-penetrating* if there are no signs of shock nor of internal hemorrhage—*i. e.* *collapse*; *fluctuation* and *dulness* in the abdominal cavity—even if there be considerable hemorrhage from the wound itself.* On the other hand, such a wound, accompanied by *shock*, *collapse*, *fluctuation*, and *dulness*, is regarded as *penetrating* even if there be absence of local hemorrhage. Furthermore, *shock* alone is not conclusive, as it may occur with non-penetrating wounds; nor does the *absence* of the signs of internal hemorrhage positively indicate that the wound is non-penetrating, because such wounds, occurring without these signs, *may be* penetrating. This point, however, is unimportant clinically, as all such wounds are regarded as *non-penetrating* as far as treatment is concerned. Hence it is clear that for a positive diagnosis of a penetrating pistol-shot wound of the abdomen, *without* wounds of the viscera, the *presence* of the *signs of internal hemorrhage* is absolutely necessary.

What are perforating wounds of the abdomen?

Wounds which have both a point of entrance and of exit, and *in which the inflicting instrument passes through the abdominal cavity*. The vast majority of these wounds are caused by bullets. Non-penetrating wounds may also have “points of entrance and exit.” Hence a differential diagnosis is necessary, and it is made on the same principles as above described.

* Shock and collapse are here necessarily intermingled. The *former* is supposed to be due to the impact of the bullet, severance of the peritoneum, injury to the viscera, etc.; the *latter* to the hemorrhage.

What is the treatment of "small wounds" of the abdomen?

If *penetrating*, laparotomy should be performed and the source of the hemorrhage sought for and ligatured. Search may then be made for possible wounds in the viscera, as they may exist without giving any symptoms (see below). If found, they are to be treated as below described; the abdomen is then cleared of blood-clots and the abdominal wound sutured.

If *non-penetrating*—*i. e.* in the absence of signs of internal hemorrhage—they are merely dressed antiseptically without exploration. The presence of pus of course always requires incision and drainage.

What is the diagnosis of penetrating wounds with accompanying wounds of the viscera?

As to the SOLID VISCERA: Wounds of these viscera are accompanied by the symptoms of shock and of "internal hemorrhage."

But, as we have already seen, shock and "internal hemorrhage" are also the symptoms of small penetrating wounds which do not involve the viscera. Therefore, unless there is *protrusion* of a solid viscus (a very rare event), or unless the wound is *large* and admits of direct examination, a differential diagnosis between these two classes of penetrating wounds cannot be made until the treatment, which is the same for both, is carried out—*i. e.* laparotomy and exploration, followed by suture of the organ.

As to the HOLLOW VISCERA: In these there is shock, and there may be *escape of gas and alimentary contents* through the wound or into the peritoneal cavity.

With protrusion the diagnosis is made certain of course by direct examination, the intestinal wounds are sutured, and the parts returned.

Without protrusion: In *large* wounds examination of the viscera is at once made through the abdominal wound, which may be enlarged if necessary as in regular laparotomy, and the visceral wounds searched for, found, sutured, the abdominal cavity cleansed from intestinal or stomache contents, if any be found, and the abdominal wound closed.

In *small* wounds (pistol-shot, etc.) there is *no protrusion*. Hence the diagnosis is never positive unless there is *escape through the wound of gas and intestinal contents* or *marked tympanitic resonance* on percussion of the abdomen, *hiding normal liver-dulness*, and thus indicating *gas in the peritoneal cavity*. But very often no such

escape of gas or contents takes place, owing to the protrusion of mucous membrane through the intestinal wound. In such cases, however, there is generally present more or less "internal hemorrhage," with its symptoms. Hence the *actual diagnosis* is that of penetrating wound with *possible* wound of the intestine. But as the indications for laparotomy are just as urgent as though the diagnosis were positive (see preceding section), no especial harm exists in failure to make this diagnosis, for the reason that laparotomy reveals the intestinal wound. Finally, it must be borne in mind that there *may be practically no symptoms* whatever; that is, a pistol-shot wound may be inflicted, causing both penetration of the abdomen and a wound of the alimentary canal, and the patient may show nothing but the signs of a moderate degree of shock, and recover perfect health without an operation.

What are the indications for laparotomy in abdominal wounds?

From what has been said, it is clear that it is only the *small* wounds about which there is any uncertainty as to the indications for operation. And, furthermore, it must also be evident that the signs of "internal hemorrhage" are the most reliable symptoms to go by. Hence, to sum up, we may say that the *indications for laparotomy* in pistol-shot and stab-wounds of the abdomen are *positive* when the *signs of "internal hemorrhage"* are well marked; that they are *urgent* when there is escape of gas or contents; and that they become, in the absence of these last, less and less positive according as "internal hemorrhage" is less and less marked, until the operation is actually contraindicated in cases whose intelligence is good, skin warm, and abdomen soft, though prostration may be marked. In such patients the wound is dressed antiseptically and the *after-treatment* is the same as that which follows laparotomy.

Pain is an inconstant symptom in wounds of the abdomen. The incision for laparotomy is usually best made in the median line, and above or below the umbilicus according to the position of the wound. If the wound is well over to the side, the incision may be made directly over it.

Discuss contusions of the abdomen.

They are of importance only as they may cause rupture or lacerated wound of any of the viscera. The symptoms of rupture are those of "internal hemorrhage" or of escape of gas into the peritoneal cavity, and the indications for laparotomy are the same as for

abdominal wounds. *Special* symptoms may also occur, likewise in abdominal wounds, which point to the wounding of a particular viscus, as hæmatemesis for the stomach; hæmaturia for the kidney; hemorrhage from the bowel for sigmoid flexure or rectum.

DISEASES OF THE RECTUM.

What is atresia ani?

It is imperforate anus, and of congenital origin. There is a membrane occluding the orifice, and it is due to failure of absorption on the part of the united hypoblast and epiblast at that point. *Incision* effects a cure.

A similar condition may involve the entire lower part of the rectum or even the whole organ. In such cases an artificial passage may be made from below up by careful dissection, or a lumbar colostomy may be indicated.

What is prolapsus ani?

This means a *protrusion* of the *mucous membrane* of the lower part of the rectum. This protrusion may occur at one point in or all around the circumference of the anal orifice.

Treatment.—By pad if of slight extent. If very large, portions may be excised by elliptical incisions, with subsequent suture of the edges, or four or five stripes with the actual cautery may be applied.

What is prolapsus recti?

This is simply *intussusception* of the rectum, and is of varying extent. It may involve only the upper part, or be so extensive that the intussusception appears at or protrudes through the anal orifice. Or the invagination may *begin right at* the muco-cutaneous junction.

Treatment.—By pressure, manual, with air or water, or resection of the protruded part. This is imperative in gangrene, and advisable when inconvenience and distress are caused.

Discuss stricture of the rectum.

This is narrowing of the calibre, and may be due to a *cicatrix* (linear, tubular, etc.) resulting from the healing of an ulcer, traumatic, syphilitic, or tubercular, or to the actual presence of these *specific* ulcers or to epithelioma or carcinoma.

Treatment.—The cicatrices should be stretched by bougies; the specific ulcers should receive local applications, and cautious dilatation when advisable; in addition, the proper constitutional remedies should be given. The malignant growths should be removed (Fig. 147).

FIG. 147.



Cicatricial Stricture of the Rectum.

How may malignant growths of the rectum be removed?

If *low down*, the rectum should be isolated and freed from all attachments by an incision surrounding the anus and carried up *beyond* the site of the growth. The rectum is then cut across *above* the growth, the portion thus left removed, and the upper portion brought down and its edges sutured to the skin.

If *high up*, one of the various operations from behind through the sacrum may be employed: an incision is made, freeing the coccyx and the lower part of the sacrum up to the third sacral vertebra. The bony structures are then removed, the growth exposed and resected. The two ends of the rectum are now sutured together and the wound packed. Or the ends may be brought out through the wound and subsequently united.

Discuss hemorrhoids.

External hemorrhoids are merely patches of hypertrophied skin occurring close to the anal orifice. They are often painful and tender. Removal is indicated. Another form is a *hæmatoma* at the muco-cutaneous junction. It should be incised, the clot turned out, and the cavity packed.

Internal hemorrhoids.—Practically, they consist of two varie-

ties—*artero-venous* and *capillary*. The former are *pedunculated*, the latter *sessile*. A hemorrhoid of the former variety is made up of a varicose vein, together with more or less thickening of the tissue of the mucous membrane surrounding the vein. Toward the lumen of the gut, however, the vein may be very near the surface, and its wall so thin that rupture and hemorrhage are liable. A small artery is often found in the centre of the pedicle (Fig. 148).

FIG. 148.



Internal Hemorrhoids with prolapse of mucous membrane. (Treves.)

The Treatment.—Seize the hemorrhoid with a clamp and ligate the pedicle by piercing it with a needle and a double ligature; tie each ligature around its half of the pedicle in a groove which has been previously cut with scissors, and cut off the portion of hemorrhoid between the clamp and ligature. Three or four are enough to remove at one time. The rectum is then packed with a large-sized rubber tube wrapped around with iodoform gauze, and a T-bandage is applied. The patient may be allowed out of bed within a week. Whitehead's and Allingham's methods differ only in technique. Essentially, each is the same, and consists in resecting that portion of mucous membrane right around the gut on which the hemorrhoids are situated, and in suturing the upper edge to the mucocutaneous margin.

The sessile varieties should be destroyed by nitric acid or the actual cautery. They are very painful and bleed readily.

What are the symptoms of internal hemorrhoids?

Pain during defecation and hemorrhage, or they may occur during the intervals. A mass can be felt protruded through the anus.

But in *all* cases of trouble with the rectum always make an examination both with sight and touch.

What are strangulated hemorrhoids?

This means the condition of internal hemorrhoids protruding through and being caught by the sphincter, so that they cannot be pushed back. This is what is often called an "acute attack of piles." Rest and wet applications will usually cause reduction in a few days. But, on the other hand, gangrene and sloughing may occur.

What is fissure of the anus?

A narrow linear ulcer of varying length seen just within the margin. It may be exquisitely painful and tender. Stretching the sphincter under ether almost always effects a cure.

Discuss fistula in ano.

It may be complete—*i. e.* with an opening on both skin and mucous-membrane surfaces; or it may have only one of these openings. In the latter case, if the opening is cutaneous, the fistula is called "blind external," but if the opening is through the mucous membrane it is a "blind internal fistula" (Fig. 149). Of course

FIG. 149.

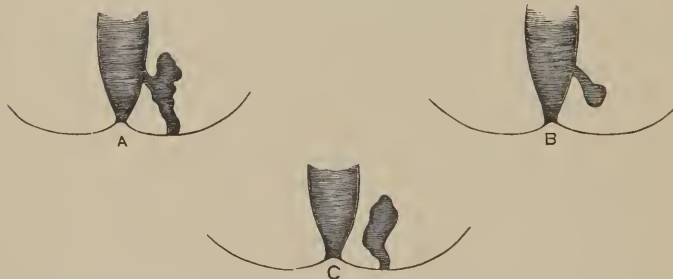


Diagram of Three Forms of Anal Fistula. A, complete fistula; B, internal blind fistula; C, external blind fistula.

both these "blind" varieties are nothing but sinuses. (See Sinus and Fistula.)

Treatment.—This consists in slitting up the fistula and in careful packing until healed of the resulting wound.

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